CAL LAB W109

MODEL 171
SYNTHESIZER/FUNCTION GENERATOR

WAVETEK

436 4731

MODEL 171
SYNTHESIZER/FUNCTION GENERATOR

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SAFETY

This instrument is wired for earth grounding via the facility power wiring. Do not bypass earth grounding with two wire extension cords, plug adapters, etc.

BEFORE PLUGGING IN the instrument, comply with installation instructions.

MAINTENANCE may require power on with the instrument covers removed. This should be done only by qualified personnel aware of the electrical hazards.

The instrument power receptacle is connected to the instrument safety earth terminal with a green/yellow wire. Do not alter this connection. (Reference: ⏚ or ⚠, stamped inside the rear panel near the safety earth terminal.)

WARNING notes call attention to possible injury or death hazards in subsequent operations.

CAUTION notes call attention to possible equipment damage in subsequent operations.

SECTION 1
INTRODUCTION

1.1 THE MODEL 171

The Wavetek Model 171 Synthesizer/Function Generator is a precision source of sine, triangle and square waveforms and dc voltage. The generator combines the precision frequency of a synthesizer with the versatility and operating convenience of a function generator. The two major modes of operation are synthesizer and function generator.

Function generator output frequency can be varied from 0.1 Hz to 2 MHz in seven ranges manually by dial and remotely by an applied voltage. In addition to this analog control of frequency, the Model 171 has a 4½ digit switch for synthesizer control of function generator frequency. The synthesizer gives precision (0.005%) frequency accuracy and stability (0.0001%/°C) from 1.000 Hz to 1.9999 MHz in six ranges. When the synthesizer is used to set the frequency, in addition to greater frequency accuracy and stability, the waveform purity is improved over that of the function generator alone.

Amplitude of the waveform is continuously variable from 10V peak-to-peak in a matching termination load (50Ω or 600Ω) down to 10 mV peak-to-peak in four ranges of attenuation (0, 20, 40, 60 dB). DC reference of the waveforms can be offset positively and negatively. The synthesizer can be locked to its own internal reference or to an external 1 MHz reference.

1.2 SPECIFICATIONS

The available waveforms, frequencies, amplitudes, operating modes, precision (accuracy) and purity (quality) are listed in the following paragraphs.

1.2.1 Versatility

Output Signals
Sine ∿ , triangle △ , square ⊓ and DC selectable. TTL pulse ⎍ , 1 MHz reference pulse ⎍ and GCV signal proportional to output frequency are also available.

Control
Generator operates in continuous mode. Frequency is controlled manually by dial or digital switch, or externally thru VCG input voltage. Digital switch is operable between 0.1000 and 1.9999 settings and works with all frequency multipliers except X 1.

Frequency Range
0.1 Hz to 2 MHz in seven overlapping ranges.

Operating Frequency Ranges

FREQ MULT	Range	Digital Resolution
X 1	0.1 Hz to 2 Hz	N. A.
X 10	0.1 Hz to 20 Hz	0.001 Hz
X 100	0.2 Hz to 200 Hz	0.01 Hz
X 1K	0.2 Hz to 2 kHz	0.1 Hz
X 10K	20 Hz to 20 kHz	1.0 Hz
X 100K	200 Hz to 200 kHz	10 Hz
X 1M	2 kHz to 2 MHz	100 Hz

NOTE

Digital switch valid with all frequency multipliers except X 1 (first range). Frequency ratio of 1000:1 on dial, 20:1 on digital switch.

Main Output
∿ , △ , ⊓ ; variable to 20V p-p into open circuit and 10V p-p with matching load at either 50Ω OUT or 600Ω OUT. DC offset of waveform (or DC if selected) is adjustable to ±10 volts open circuit and ±5 volts into matching load. Waveform plus offset is limited to ±10V peak (open circuit).

Output waveforms can be attenuated from 0 dB to 80 dB: 60 dB in 20 dB steps plus a 20 dB vernier for continuous variation (20 dB vernier does not affect offset or DC output).

Optional output protection circuit of zeners and fuses protect both output and common sides from inadvertent connection to external voltage or ac line.

DC Offset and DC Output
DC offset of waveform and DC output are selectable and variable thru ±10V (±5V into matching load). Waveform plus offset is limited to ±10V peak (open circuit). Step attenuator attenuates dc level.

Generator Frequency TTL Output
TTL pulse has an approximately 50% duty cycle at generator frequency and can drive up to 20 TTL loads.

Optional TTL buffer circuit provides high power TTL compatible signal capable of driving load impedances as low as 50Ω.

GCV (Generator Controlled Voltage) Output
0 to +2V (nominal, open circuit) proportional to frequency of main generator. Output impedance 600Ω.

VCG (Voltage Controlled Generator) Input
In function generator mode only, VCG voltage as well as dial settings select generator frequency. Frequency may be dc-programmed or ac-modulated by external 0 to 2V signal. Input impedance is 2 kΩ. VCG input can change generator output 1000:1 in function generator mode on all ranges (limited by a minimum VCG frequency of 0.1 Hz).
VCG Input Signal Bandwidth: 100 kHz.
VCG Slew Rate: 0.1 V/μs.

External Reference Input
1 MHz sine or square wave external reference clock signal of 1 Vrms to 10 Vrms. 5 kΩ input impedance.

Reference Output
TTL level 1 MHz pulse train output when in the synthesizer mode.

Optional TTL buffer circuit provides high power TTL compatible signal capable of driving load impedances as low as 50Ω.

1.2.2 Operating Modes

Synthesizer
Operates as a synthesizer with function generator outputs locked to the synthesizer frequency. The frequency is determined by the frequency multiplier switch and the digital switch settings. The digital switch is operable from 0.1000 and 1.9999 on all ranges above the X 1 range.

Voltage Controlled Generator (VCG)
Operates as a conventional VCG. The frequency is controlled by the dial, multiplier switch and external VCG voltage on all ranges.

1.2.3 Horizontal Precision

Synthesizer Operation
Accuracy: 0.005% of setting.
Stability: 1 ppm per degree C.
Internal Frequency Standard: 4 MHz crystal with an aging rate of 20 ppm per year.
Locking Time: Within 10% of final frequency in < 100 ms; within 0.01% of final frequency on X 1K, X 10K, X 100K and X 1M ranges in < 300 ms, X 100 in < 2s, X 10 in < 20s.

Dial/VCG Operation
Dial Accuracy: ±3% of full scale for 0.1 Hz to 200 kHz; ±5% of full scale for 200 kHz to 2 MHz.
Time Symmetry
±1% on all ranges except X 1M range.

1.2.4 Vertical Precision

Amplitude Change With Frequency (Sine)
Less than ±0.1 dB on all ranges thru X 100K.
Less than ±0.5 dB on X 1M range.

1.2.5 Waveform Purity

Harmonic Distortion
Less than 0.5% to 20 kHz (typically 0.2%).
Less than 1.0% to 200 kHz (typically 0.5%).
All harmonics 30 dB below fundamental on X 1M range.

Spurious Signals
Typically 70 dB below fundamental to 20 kHz and 40 dB below fundamental to 2 MHz (in synthesizer mode only).

Integrated Signal to Phase Noise
Typically 30 dB to 200 kHz measured over ±15 kHz bandwidth excluding carrier ±10 Hz (in synthesizer mode only).

Square Wave Rise and Fall Time
Less than 75 ns.

Triangle Linearity
Greater than 99% to 200 kHz.

TTL Pulse Rise and Fall Time
Less than 25 ns (15 ns typical).

1.2.6 Environmental

Specifications apply at 25°C ±5°C. Instrument will operate from 0°C to +50°C.

1.2.7 Mechanical

Dimensions
11¼ in./28.6 cm wide; 5¼ in./13.3 cm high; 10¾ in./27.3 cm deep.

Weight
8.5 lb/3.85 kg net; 12 lb/5.5 kg shipping.

1.2.8 Power

90 to 110V, 105 to 125V, 180 to 220V or 210 to 250V; 50 to 400 Hz; less than 18 watts.

NOTE

All specifications apply when frequency dial is between 0.1 and 2.0 or digital switch is between 0.1000 and 1.9999, amplitude is at 10V p-p and output is from the 50Ω BNC into a 50Ω load.

SECTION 2
INITIAL PREPARATION

2.1 UNPACKING INSPECTION

After carefully unpacking the instrument, inspect the external parts for damage to knobs, dials, indicators, surface areas, etc. If there is damage, file a claim with the carrier who transported the instrument. Retain the shipping container and packing material for use in case reshipment is required.

2.2 PREPARATION FOR USE

Before connecting the instrument to line power, be sure the rear panel 115/230V and HI/LO switches are set to the value nearest the line voltage and that the fuse is correct for the switch setting. Be sure that the plug on the power cord is the proper mate for the line receptacle.

AC Line Voltage	Switch A	Switch B	Fuse (SB)
90 - 110	115	LO	3/8 amp
105 - 125	115	HI	3/8 amp
180 - 220	230	LO	3/16 amp
210 - 250	230	HI	3/16 amp

2.3 ELECTRICAL ACCEPTANCE CHECK

This checkout procedure verifies the generator operation. If a malfunction is found, refer to the Warranty in the front of the manual. An oscilloscope, counter, three short lengths of 50Ω coax cable, a 50Ω feedthru load and a 0 to ±2V voltage source are required (figure 2-1). Circled numbers index controls and connectors to figure 3-1.

1. Preset the generator front panel controls as follows:

Control	Position
Frequency Dial (1)	1.0
FREQ MULT	X 1K
Digital Switch (4)	1.9999
DC OFFSET	OFF
Waveform Selector (6)	∿
AMPLITUDE	Full cw
ATTENUATION	0
Dial/Digital Switch (2)	Toward Dial

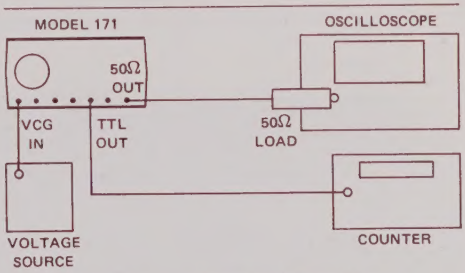


Figure 2-1. Performance Checkout Setup

Table 2-1. Performance Checkout

Step	Control	Position/Operation	Observe
	Function		
1	Adjust the oscilloscope for several cycles of sine wave.		
2	Waveform Selector	∿ , ⊔ , DC, ∿	Waveform changes from ∿ to ⩘ to ⊔ to a 0V dc level then ∿ .
	Amplitude		
1	AMPLITUDE	Ccw to 12 o'clock	Waveform amplitude reduces.

Table 2-1. Performance Checkout (Continued)

Step	Control	Position/Operation	Observe
2	DC OFFSET	9 o'clock, then slowly to full cw (return to OFF)	Waveform offset negatively, then positively (clipping may occur).
3	ATTENUATION	20, 40, 60 (return to 0)	Waveform amplitude decreases with each step.
Outputs			
1	Remove 50Ω load and reconnect cable. Remove the 50Ω OUT connection and place it on the 600Ω OUT BNC.		Unloaded 50Ω OUT and 600Ω OUT are identical.
2	Remove the 600Ω OUT connection and place it on the TTL OUT.		Square pulse at 1 kHz.
3	Remove the TTL OUT connection and place it on the REF OUT. Flip dial/digital switch selector to digital switch side.		1 MHz pulse.
4	Remove the REF OUT connection and place it on the GCV OUT.		2 Vdc level.
5	Flip dial/digital switch selector to dial side.		1 Vdc level.
Frequency			
1	Remove GCV OUT connection and place on 50Ω OUT.		
2	FREQ MULT	Use each multiplier X 1 thru X 1M (return to X 1).	Observe an increase in frequency while stepping from X 1 to X 1M.
3	Dial	Vary from 2.0 to .2 (return to .2).	Observe a corresponding change in frequency.
4	Connect a 0 to ±2V source to the VCG IN BNC. Vary the voltage positively.		Observe a change in frequency proportional to the change in VCG voltage.
5	Dial	2.0	
6	Voltage Source	Vary the voltage negatively.	Observe a change in frequency proportional to the VCG voltage.
7	Disconnect the voltage source.		
8	Dial/Digital Switch Selector	Switch toward the digital switch.	1.9999 kHz.
9	Digital Switch	Set each position of the digital switch.	Observe counter readout corresponding to set of digital switch.

SECTION 3
OPERATION

3.1 CONTROLS AND CONNECTORS

The generator front panel controls and connections shown in figure 3-1 are keyed by circled numbers to the following descriptions.

(1) **Frequency Dial**

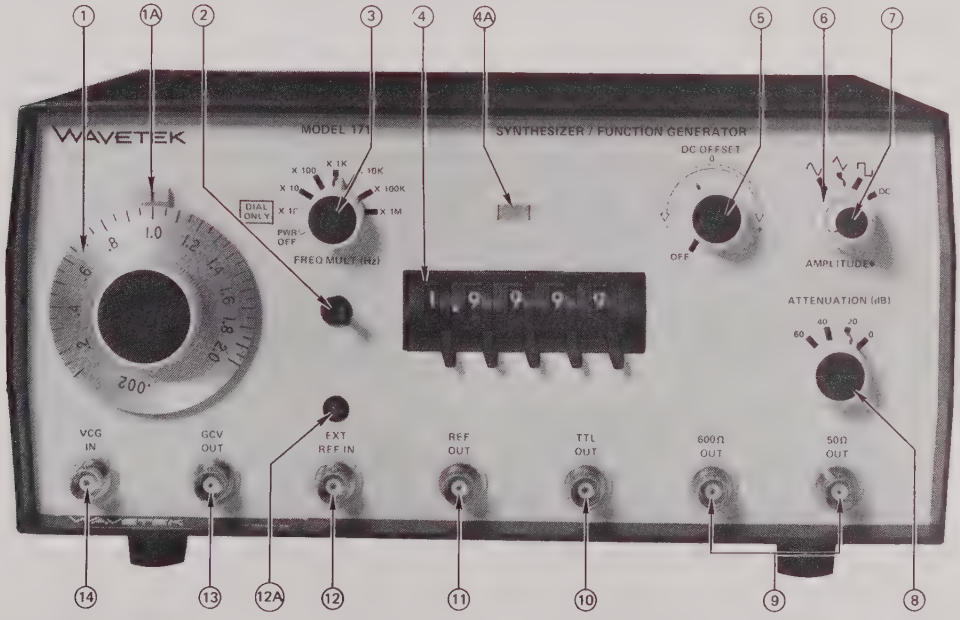
When the frequency dial is selected by the dial/digital switch selector (2) the index (1A) lights and the frequency output is determined by the dial, FREQ MULT (3) and VCG (14) voltage.

(2) **Dial/Digital Switch Selector**

Places the instrument in either function generator (dial controlled) or synthesizer (digital switch controlled) mode. Respective dial index (1A) or digital switch index (4A) lights to indicate operation mode.

(3) **FREQ MULT (Hz)**

Power is turned on when frequency range is selected at FREQ MULT. The multipliers are for the dial (1) and digital switch (4) readings and the VCG (14) voltage.



④ **Digital Switch**

When the digital switch is selected by the dial/digital switch selector ② the index 4A lights and the frequency output is determined by the digital switch and the FREQ MULT.

⑤ **DC OFFSET**

Rotating DC OFFSET clockwise past 12 o'clock offsets dc output or dc center reference of the output waveform positive; when counterclockwise, negative. When OFF, the dc output is signal ground or the output waveform is balanced around signal ground (0V in figure 3-2).

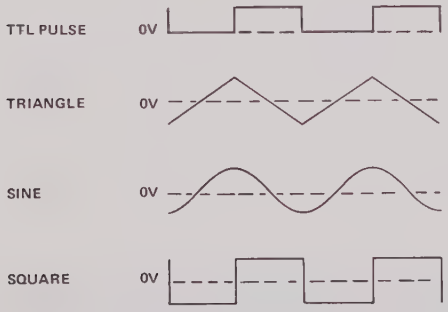


Figure 3-2. Output Waveforms

⑥ ∿ , ∿ , ⊓ and DC (Waveforms)

Sine ∿ , triangle ∿ and square ⊓ waveforms are selected by the larger of the two concentric controls; the DC position provides a dc voltage output controlled by DC OFFSET. Outputs appear at 50Ω OUT and 600Ω OUT.

⑦ **AMPLITUDE**

Rotating AMPLITUDE fully clockwise provides maximum peak-to-peak output at 50Ω OUT and 600Ω OUT; rotating counterclockwise gives up to 20 dB attenuation. Also see ATTENUATION ⑧. AMPLITUDE does not affect dc offset or dc output.

⑧ **ATTENUATION**

With a 600Ω load on the 600Ω OUT connector or a 50Ω load on the 50Ω OUT connector, output voltage for each attenuation is:

Attenuation	Amplitude Control Full cw	Amplitude Control Full ccw
0	10V p-p	1V p-p
20	1V p-p	100 mV p-p
40	100 mV p-p	10 mV p-p
60	10 mV p-p	(Not specified)

⑨ **600Ω OUT and 50Ω OUT Connectors**

600Ω OUT and 50Ω OUT provide variable frequency and amplitude ∿ , ∿ , ⊓ and DC. Maximum signal amplitude is 10V p-p with matching loads (20V p-p into open circuit).

⑩ **TTL OUT Connector**

A fixed amplitude Transistor-Transistor Logic (TTL) square pulse train of the output frequency. (TTL levels are 0V to 0.4V for a logic low and 2.4V to 5V for a logic high.) The output can drive up to 20 TTL loads. The pulse train can also be used as a synchronizing reference to 50Ω OUT and 600Ω OUT. Phase of output waveforms relative to the TTL pulse is shown in figure 3-1.

⑪ **REF OUT Connector**

A fixed amplitude Transistor-Transistor Logic (TTL) pulse train of 1 MHz whose origin is an internal clock oscillator or, if indicator 12A is lit, the external reference signal of 1 MHz.

⑫ **EXT REF IN Connector**

Input for a 1 MHz sine or square wave external reference clock signal. The signal must be at least 1 Vrms. Synthesizer frequencies are referenced to this signal when indicator 12A is lit.

⑬ **GCV OUT Connector**

DC excursions at the Generator Controlled Voltage output (GCV OUT) of 0V to about 2V proportionally represents frequency within the range indicated by FREQ MULT.

⑭ **VCG IN Connector**

DC excursions at the Voltage Controlled Generator input (VCG IN) proportionally control frequency within the range determined by FREQ MULT. Positive voltage increases the frequency set by the dial ① ; negative voltage decreases the frequency. Use in function generator mode only.

3.2 OPERATION

Operation is described as function generator operation and synthesizer operation. The generator is ready to operate as soon as a frequency multiplier is selected.

3.2.1 Signal Termination

Proper signal termination, or loading, of the generator connectors is necessary for its specified operation. For example, the proper termination of the 50Ω OUT connector is shown in figure 3-3. Placing the 50 ohm terminator, or 50 ohm resistance, in parallel with a higher impedance, matches the receiving instrument input impedance to the generator output impedance, thereby minimizing signal reflection or power loss on the line due to impedance mismatch.

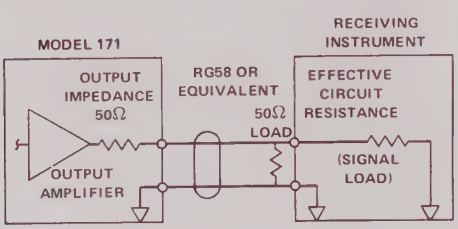


Figure 3-3. Signal Termination

The input and output impedances of the generator connectors are listed below:

Connector	Impedance
50Ω OUT	50Ω
600Ω OUT	600Ω
TTL OUT	*
REF OUT	*
VCG IN	2 kΩ
GCV OUT	600Ω
REF IN	5 kΩ

*The TTL OUT connector can drive up to 20 Transistor-Transistor Logic (TTL) loads (low level between 0V and 0.4V, and high level between 2.4V and 5V). REF OUT can drive up to 3 TTL loads. Addition of the TTL buffer option gives these outputs the capability of driving a 50Ω load.

3.2.2 Manual Function Generator Operation

For basic operation, select the waveform frequency and amplitude. The following steps demonstrate manual control of the function generator. (Circled numbers are keys to figure 3-1.)

Step	Control/Connector	Setting
1	50Ω OUT or 600Ω OUT	Connect circuit to either output (refer to paragraph 3.2.1).
2	Dial/Digital Switch Selector (2)	Set toward the dial.
3	FREQ MULT	Set to desired range of frequency.
4	Frequency Dial (1)	Set to desired frequency within the range.
5	Waveform Selector (6)	Set to desired waveform.
6	DC OFFSET	Set as desired. Limit waveform amplitude to prevent clipping (see figure 3-4).
7	AMPLITUDE and ATTENUATION	Select for desired amplitude.

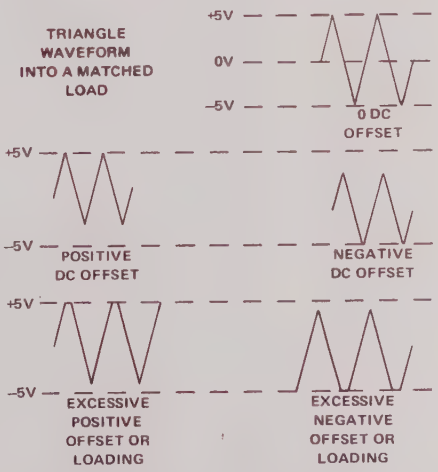


Figure 3-4. DC OFFSET Control

3.2.3 Voltage Controlled Function Generator Operation

Operation as a voltage controlled function generator (VCG) is as for a manually controlled function generator, only the frequency within particular ranges is additionally controlled with dc levels (±2V excursions) injected at the VCG IN connector. Perform the steps given in paragraph 3.2.2, only set the frequency dial to determine a reference from which the frequency is to be voltage controlled.

1. For frequency control with positive dc inputs at VCG IN, set the dial for a lower frequency limit.

2. For frequency control with negative dc inputs at VCG IN, set the dial for an upper frequency limit.

3. For modulation with an ac input at VCG IN, set the dial at the desired center frequency. Do not exceed the maximum dynamic range of the selected frequency range.

Figure 3-5 is a nomograph with examples of dial and voltage effects. Example 1 shows that with 0V VCG input, frequency is as determined by the main dial setting, 1.0 in this example. Example 2 shows that with a positive VCG input, output frequency is increased. Example 3 shows that with a negative VCG input, output frequency is decreased. (Note that the Output Frequency Factor column value must be multiplied by a frequency range multiplier to give the actual output frequency.)

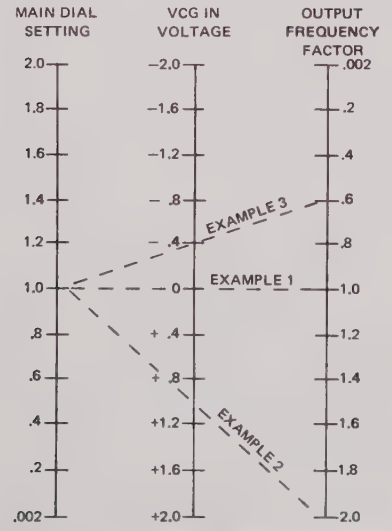


Figure 3-5. VCG Voltage-to-Frequency Nomograph

NOTE

Nonlinear operation results when the VCG input voltage is excessive; that is, when the attempted generator frequency exceeds the range setting (2 times the multiplier setting) or in the other direction, 1/1000th of the range setting.

The up to 1000:1 VCG sweep of the generator frequencies available in each range results from a 2V excursion at the VCG IN connector. With the frequency dial set to 2.0, excursions between −2V and 0V at VCG IN provide the up to 1000:1 frequency sweep. With the dial set to .002, excursions between 0V and +2V at VCG IN provide the up to 1000:1 sweep within the set frequency range.

3.2.4 Synthesizer Operation

For synthesizer operation, select the waveform, frequency and amplitude. The following steps demonstrate synthesizer control. (Circled numbers are keys to figure 3-1.)

Step	Control/Connector	Setting
1	50Ω OUT or 600Ω OUT	Connect the circuit to either output (refer to paragraph 3.2.1).
2	Dial/Digital Switch Selector (2)	Set toward digital switch.
3	FREQ MULT	Set to desired range of frequency.
4	Digital Switch (4)	Set to desired frequency within the range.
5	Waveform Selector (6)	Set to desired waveform.
6	DC OFFSET	Set as desired. Limit waveform amplitude to prevent clipping (see figure 3-4).
7	AMPLITUDE and ATTENUATION	Select desired amplitude.

Synthesizer frequencies are normally referenced to an internal crystal oscillator. However, an external 1 MHz sine or square wave reference signal can be applied at REF IN; the indicator (13A) will light, indicating a proper external reference in use.

3.2.5 Monitoring the Synthesizer/Function Generator

Besides the 50Ω OUT and 600Ω OUT main generator outputs, the GCV OUT connector supplies a voltage proportional to the generator frequency, the TTL OUT connector supplies a TTL compatible pulse train at the generator frequency, and the REF OUT supplies a TTL compatible 1 MHz pulse train.

The GCV OUT signal is used to drive the frequency axis of an X-Y recorder or oscilloscope; the generator frequency TTL OUT signal is used to synchronize other devices to the generator or to drive TTL level inputs, and the REF OUT signal is used to reference other 171's to a master crystal oscillator.

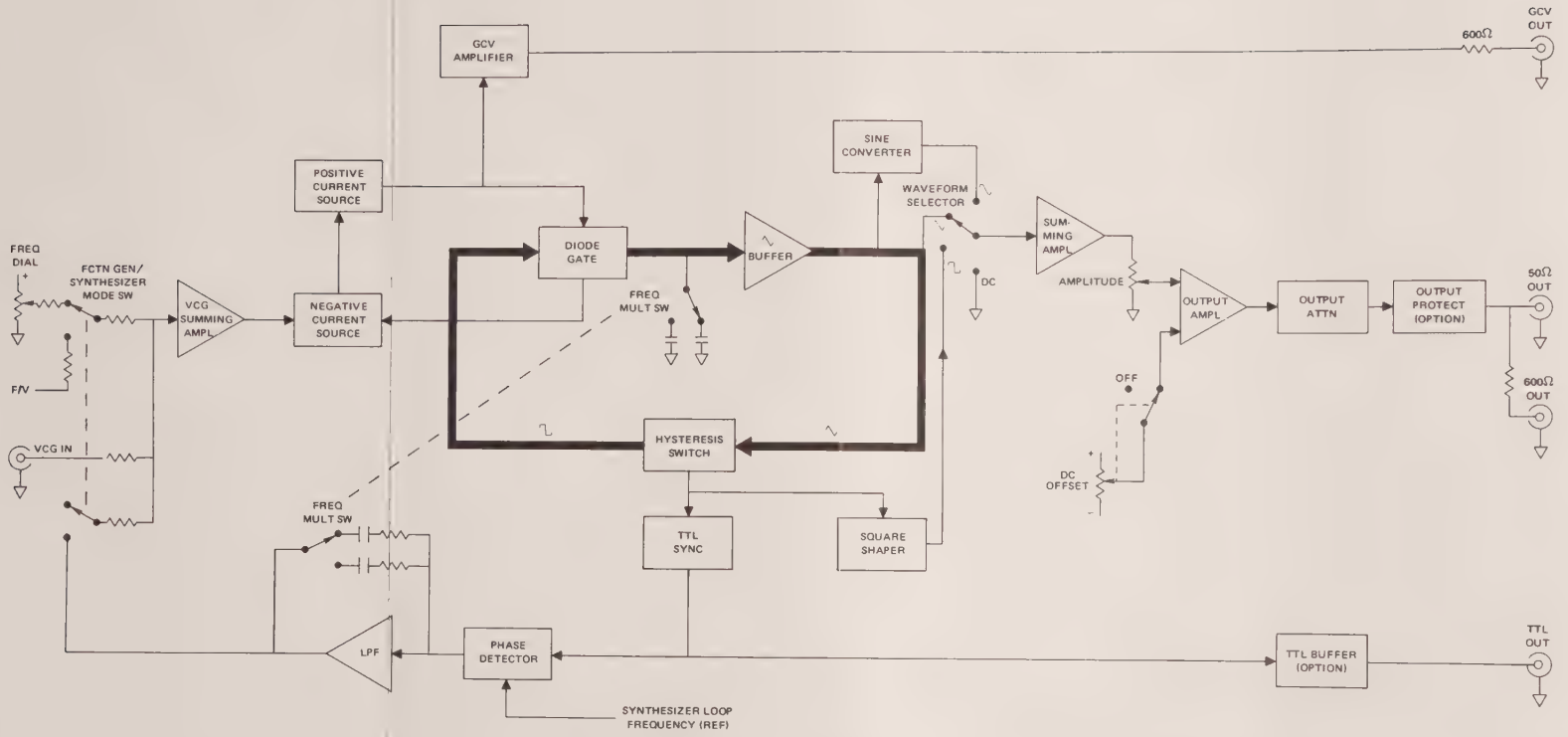


Figure 4-1. Function Generator Block Diagram

SECTION 4
CIRCUIT DESCRIPTION

4.1 FUNCTION GENERATOR

As shown in figure 4-1, the VCG summing amplifier sums the currents from the frequency dial and VCG input connector in function generator mode or from the low pass filter output and the frequency-to-voltage (F/V) converter output in synthesizer mode. The low pass filter is part of the generator frequency phase lock loop which provides a feedback current that corrects generator frequency to be exactly that of the synthesizer loop output. (Phase lock loop operation is described in paragraph 4.5.) The F/V input is also from the synthesizer loop and provides a gross correction to increase the response time of the generator to changes in synthesizer frequency programming.

The VCG summing amplifier is a noninverting buffer whose output current is used to control a positive current source and a negative current source. The currents from the two current sources are equal and opposite polarity and the magnitudes are directly proportional to the current of the VCG summing amplifier output. The diode gate, which is controlled by the hysteresis switch, is used to switch the positive current or the negative current to the integrating capacitor selected by the frequency multiplier. If the positive current is switched into the capacitor, the voltage across the capacitor will increase linearly to generate the positive slope of the triangle wave. If the current is negative, the voltage across the capacitor will decrease linearly to produce the negative slope.

The triangle buffer amplifier is a unity gain amplifier whose output is fed to the hysteresis switch as well as to the sine converter. The hysteresis switch has two voltage limit points (+1.25V and −1.25V). (See figure 4-2.)

During the time the output voltage of the triangle buffer amplifier is increasing, the output voltage of the hysteresis switch is positive, but when the output voltage of the triangle amplifier reaches +1.25V, it triggers the hysteresis switch causing the switch output to become negative. Once the control voltage into the diode gate becomes negative, it will switch the positive current out and switch the negative current in to the integrating capacitor, starting a linear decrease of the voltage across the capacitor. When the decreasing voltage reaches −1.25V, the output of the hysteresis switch will switch back to positive, reversing the process. This action generates the triangle waveform as shown in figure 4-2. Since the output of the hysteresis switch is a square wave, the result is simultaneous generation of a square wave and triangle wave at the same frequency.

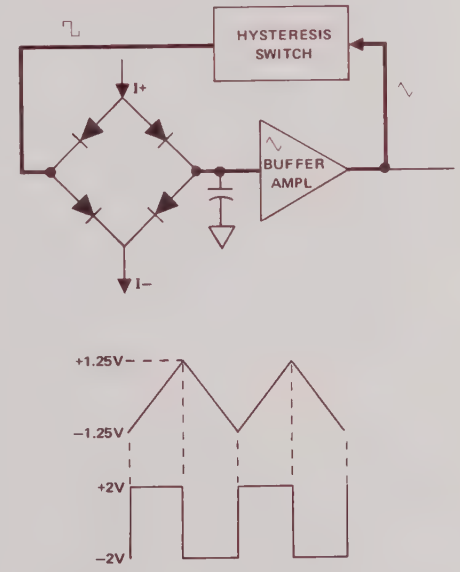


Figure 4-2. Generator Loop and Waveforms

4.2 FREQUENCY CONTROL

The output frequency is determined by the magnitude of the integrating capacitor selected by the frequency multiplier and the magnitude of the positive and negative current sources (figure 4-1). Since the current magnitudes are linearly proportional to the sum of the VCG current, the output frequency will also be linearly proportional to the current sum.

By using current division, the magnitude of the capacitor is effectively increased, allowing the generation of lower fre-

quencies. Figure 4-3 is the simplified diagram showing current divider operation. By reducing integration current precisely by a factor of 10 while holding triangle wave amplitude constant, it is possible to extend the lower frequency range by a factor of 10 with fixed capacitance C. Since points A and B are at the equipotential points, constant current output I can be divided by resistance ratio of R and 9R. Then, integration current of capacitor C is reduced to 0.1 I. The lower current extends the frequency range of the function generator by a factor of 10. The same theory is applied to extend the frequency range by a factor of 100.

4.3 WAVEFORM OUTPUT

The inverted output of the hysteresis switch is fed to the TTL buffer amplifier and also the square wave shaper (figure 4-1). The square wave shaper consists of a shaping circuit which limits the output swing to ±1.25 volts.

The output signal from the triangle buffer amplifier is applied to the sine converter, which uses a diode-resistor network with nonlinear sections to shape a sine wave.

The sine, triangle or square waveform is fed to the summing amplifier through the waveform selector switch. The output of summing amplifier is fed through the amplitude control to the output amplifier. The output amplifier is an inverting amplifier whose output is capable of driving 10V p-p into selected load impedance.

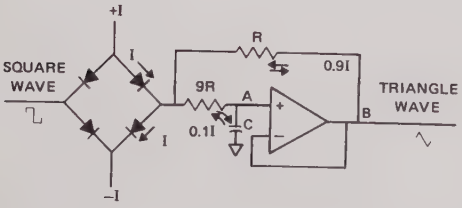


Figure 4-3. Current Divider

4.4 OUTPUT ATTENUATOR AND PROTECTION CIRCUIT

The signal from the output amplifier is routed through an attenuation network for step attenuation. If the optional protection circuit is installed, the instrument output circuits are protected from input voltages by a zener and fuse network protecting both the signal and ground sides of the output BNC's. Two source impedances, 50 and 600 ohms, are provided at the outputs.

4.5 PHASE LOCK LOOP

A phase lock loop is shown in figure 4-4. The phase detector output is proportional to the difference in frequency between the two inputs. This difference signal is used to control a voltage controlled oscillator (VCO). The VCO output signal is fed back to the phase detector, where the VCO frequency is compared to the reference input to the detector. This reference input is, for example, a constant 1.0000 kHz signal. The loop becomes stable when the VCO frequency equals the reference frequency, at which time the detector difference signal becomes zero.

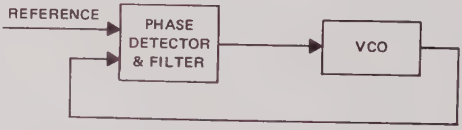


Figure 4-4. Phase Lock Loop

4.6 SYNTHESIZER LOOP

The reference frequency for the synthesizer is provided by an internal 4 MHz crystal or by an external 1 MHz signal (figure 4-5). Either source provides a 1 MHz REF OUT signal which is also reduced to 1.0000 kHz for the reference input to the phase detector.

The phase detector difference signal is a pulse train whose spacing and magnitude reflect the phase difference. The low pass filter (LPF) shown in the synthesizer loop converts this pulse train to a voltage inversely proportional to the phase difference. Noise, particularly 1 kHz, is filtered by the 400 Hz cutoff filter. The dc voltage controls the VCO frequency using a varactor diode as the tunable element.

The programmable divider in the loop (÷ P) is controlled by the front panel digital switch; for any division of frequency programmed, the loop rapidly drives the phase detector's other input to 1.0000 kHz. For example, if divide by 16000 is programmed, an imbalance is initially set up and the VCO frequency is increased such that $f_{VCO} \div 16000 = 1.0000$ kHz, which returns the loop to a stable condition. (The VCO frequency (f_{VCO}) was 16 MHz.)

The VCO has a tunable range of only 3:1, hence the VCO range has been limited to 8 to 20 MHz. When below 8 MHz from the VCO would be required,a prescaler is placed in the loop, which is also controlled by the digital switch, to keep the division factor large, which in turn keeps VCO frequency greater than 8 MHz. The prescaler output is a 1M to 20 MHz signal. The output of the prescaler is divided by 10 before the frequency ranging circuit to give the frequency equivalent to the digital switch programmed value. The resulting fre-

quency is divided by a multiple of 10, as controlled by the FREQ MULT range switch, and fed to the function generator phase lock loop (figure 4-1).

A 10k to 200 kHz output is used to create the F/V signal which gives rapid function generator response to frequency changes. A one-shot changes the signal to fixed width pulses whose spacing is frequency dependent. These are converted to a frequency dependent voltage level at the F/V converter output.

One pole of the function generator/synthesizer mode switch furnishes the ground signal CLK KILL. CLK KILL stops synthesizer loop activity when the instrument is in function generator mode or set on X 1, a dial-only range. Lamps indicating mode are also controlled by this CLK KILL.

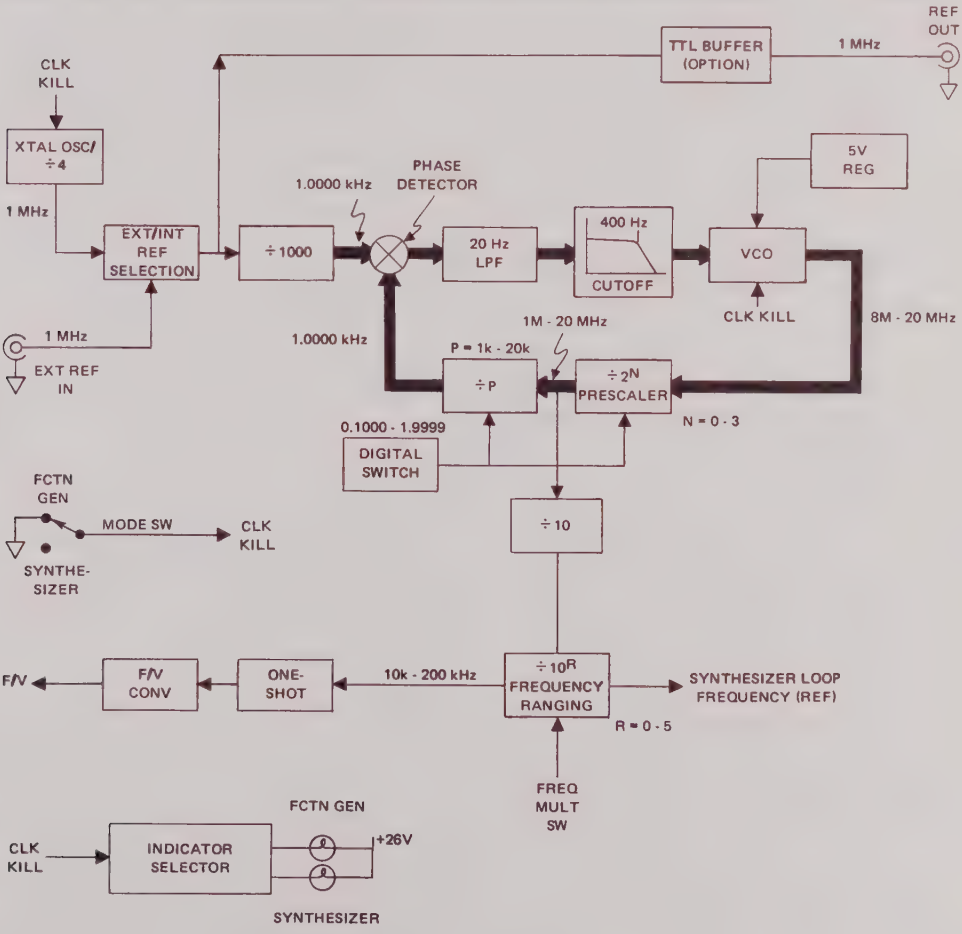


Figure 4-5. Synthesizer Phase Lock Loop

SECTION 5
CALIBRATION

5.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

5.2 REQUIRED TEST EQUIPMENT

DVM (3½ digit)

Distortion Analyzer (1% F.S.) HP334A

Oscilloscope (≥ 40 MHz bandwidth, X 10 horizontal magnification, dc triggering to 1 Hz)

BNC Termination (50Ω ≤ 1%, ≥ 1W)

Frequency Counter (6 digits, time base accuracy ≥ 50 ppm)

Low Frequency Spectrum Analyzer HP3580A

5.3 REMOVING GENERATOR COVER

For main board access, remove the four screws in the lower cover, place the instrument on its feet and lift off the top cover. For later access to the synthesizer board, remove the four screws from the inside corners of the lower board that attach it via standoffs to the lower cover. Do not remove the lower cover unless necessary, because it supports front and rear panels.

5.4 CALIBRATION

After referring to the following preliminary data, perform calibration, as necessary, per table 5-1. If performing partial calibration, check previous settings and adjustments for applicability.

1. Unless otherwise noted, all measurements made at the 50Ω OUT connector should be terminated into a 50Ω (≤ 1%, 1W) load.

2. Before connecting the unit to an ac source, check the ac line circuit to make sure the 115/230 volt switch is set at the correct position (see paragraph 2.2).

3. Start the calibration by setting the front panel switches as follows:

Dial 2.0
FREQ MULT ..... X 1K
Mode (toggle switch) ..... Toward Dial
Digital Switch 0.1000
DC OFFSET ..... OFF
Function ..... DC
AMPLITUDE ..... ccw
ATTENUATION 0

4. Allow the unit to warm up at least 30 minutes for final calibration. Start the calibration on main board. All test points are located on the main board.

Table 5-1. Calibration Chart

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
1	Power supply regulation	DVM	TP2 (TP1 ground)		R20	+15 ±0.01V	Main board
2			TP3 (−15V)			−15 ±0.05V	
3	Output dc balance	Scope or DVM	50Ω OUT		R116	0 ±0.01 Vdc	
4				AMPLITUDE: cw	R141		

Table 5-1. Calibration Chart (Continued)

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
5	Distortion	Distortion analyzer (50Ω terminated	50Ω OUT	Function ∿	R72 R93	Minimum distortion	
6	VCG null	Scope		FREQ MULT: X 100K Function: ⊓ Dial: full cw Scope vert: 2V/div Scope horiz: .5 ms/div	R40	Minimum frequency shift	Adjust generator dial to display one cycle on scope. Alternately short and open VCG IN BNC while adjusting R40.
7	Horizontal symmetry			Scope Horiz: X 10 on	R42	Maximum symmetry	Alternately switch scope triggering from positive to negative slope while adjusting R42.
8				Dial: 01 FREQ MULT: X 10 Scope sweep: 0.1s/div, dc triggering	R60		
9	Frequency accuracy	Counter		Dial: 2.0 FREQ MULT: X 1 thru X 10K	R32	Best frequency accuracy over X 1 thru X 10K	
10				FREQ MULT: X 1M Function: ⊓ Dial: 2.0	C37	2.020 MHz	
11				Function: ⊓, ∿, ∿		Best frequency tracking on X 1M range	
12	Internal reference		REF OUT	Mode toggle switch: towards digital switch	C1	1 MHz ±20 Hz	C1 is on synthesizer board.
13	F/V balance	Scope or DVM	TP5 (TP1 common)	FREQ MULT: X 10K Digital Switch: 0.1000	R31	0 ±0.1 Vdc	
14	F/V gain			Digital Switch: 0.9999	R28	+1 Vdc approx	
15				Digital Switch: 1.9999		−1 Vdc approx	If necessary, reset R28 for best balance between 0.9999 and 1.9999.
16	Frequency range	Counter	50Ω OUT	FREQ MULT: X 1M thru X 10 Function: ⊓		Reading ±0.005% each setting	

Table 5-1. Calibration Chart (Continued)

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
17	Frequency bits	Counter	50Ω OUT	FREQ MULT: X 10K Digital Switch: 0.1111 thru 0.9999		Proper reading on counter	
18	Spectral purity	Spectrum Analyzer		Function: ∿ Digital Switch: 1.9999		Spurious signals below −70 dB. Noise floor below −60 dB	Set 3580A controls for a 3 Hz bandwidth with minimum smoothing; scanning 20 Hz/div at 5s/div. Check that average of noise floor at f_0 + 3 Hz is below −60 dBc and that no line related spurs are above −70 dBc. **Keep power lines away from analyzer input.**

SECTION 6
TROUBLESHOOTING

6.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

6.2 TROUBLESHOOTING CHART

Troubleshooting charts are given in figures 6-1 thru 6-4. The charts do not cover every possible trouble, but will be an aid in systematically isolating faulty components.

Figure 6-1. Initial Checks

Figure 6-2. Generator Mode Checks

Sheet 1 Generator Check
Sheet 2 Generator Loop Check
Sheet 3 VCG Check
GCV Check
TTL Check

Figure 6-3. Power Supply Checks

Figure 6-4. Synthesizer Mode Checks

Sheet 1 F/V Check
Sheet 2 Synthesizer Loop Checks
Sheet 3 Synthesizer Loop Checks
Sheet 4 Frequency Ranging Check
Sheet 5 Generator Phase Lock Loop Check
Sheet 6 Reference Selector Check

6.3 TROUBLESHOOTING INDIVIDUAL COMPONENTS

6.3.1 Transistor

1. A transistor is defective if more than one volt is measured across its base emitter junction in the forward direction.
2. A transistor when used as a switch may have a few volts reverse bias voltage.
3. If the collector and emitter voltages are the same, but the base emitter voltage is less than 500 mV forward voltage (or reversed bias), the transistor is defective.
4. A transistor is defective if its base current is larger than 10% of its emitter current (calculate currents from voltage across the base and emitter series resistors).
5. In a transistor differential pair (common emitter stages), either their base voltages are the same in normal operating condition, or the one with less forward voltage across its base emitter junction should be off (no collector current); otherwise, one of the transistors is defective.

6.3.2 Diode

1. A diode is defective if there is greater than one volt (typically 0.7 volt) forward voltage across it.

6.3.3 Operational Amplifier (e.g., UA741C, LM318)

1. The "+" and "–" inputs of an operational amplifier will have less than 15 mV voltage difference when operating under normal conditions.
2. If the output voltage stays at maximum positive, its "+" input voltage should be more positive than its "–" input voltage, or vice versa; otherwise, the operational amplifier is defective.

6.3.4 Capacitor

1. Shorted capacitors have zero volts across their terminals.
2. Opened capacitor can be located (but not always) by using a good capacitor connected in parallel with the capacitor under test and observing the resulting effect.

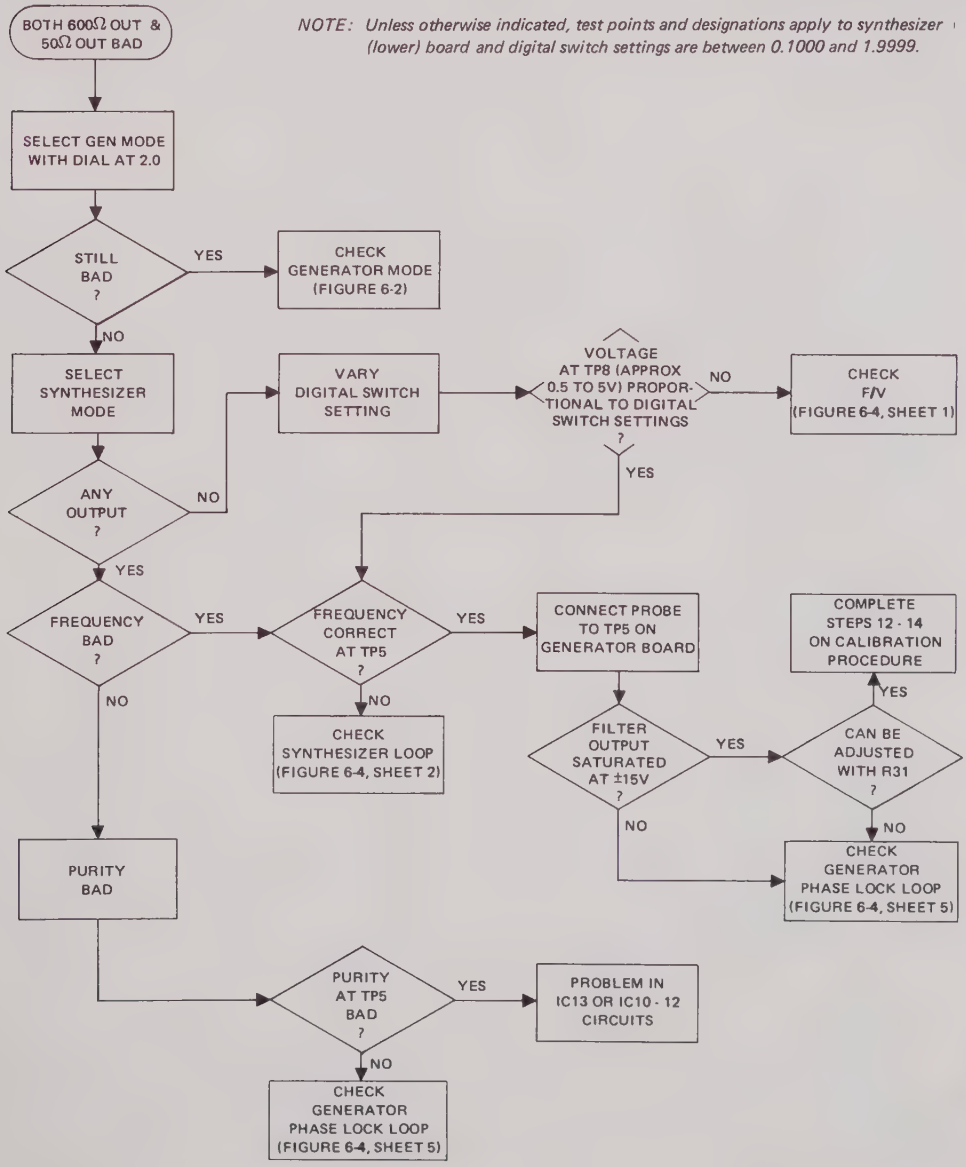

BOTH 600Ω OUT & 50Ω OUT BAD
NOTE: Unless otherwise indicated, test points and designations apply to synthesizer (lower) board and digital switch settings are between 0.1000 and 1.9999.
SELECT GEN MODE WITH DIAL AT 2.0
STILL BAD ?
YES
CHECK GENERATOR MODE (FIGURE 6-2)
NO
SELECT SYNTHESIZER MODE
VARY DIGITAL SWITCH SETTING
VOLTAGE AT TP8 (APPROX 0.5 TO 5V) PROPORTIONAL TO DIGITAL SWITCH SETTINGS ?
NO
CHECK F/V (FIGURE 6-4, SHEET 1)
YES
ANY OUTPUT ?
NO
YES
FREQUENCY BAD ?
YES
FREQUENCY CORRECT AT TP5 ?
YES
CONNECT PROBE TO TP5 ON GENERATOR BOARD
COMPLETE STEPS 12 - 14 ON CALIBRATION PROCEDURE
NO
CHECK SYNTHESIZER LOOP (FIGURE 6-4, SHEET 2)
FILTER OUTPUT SATURATED AT ±15V ?
YES
CAN BE ADJUSTED WITH R31 ?
YES
NO
NO
CHECK GENERATOR PHASE LOCK LOOP (FIGURE 6-4, SHEET 5)
PURITY BAD
PURITY AT TP5 BAD ?
YES
PROBLEM IN IC13 OR IC10 - 12 CIRCUITS
NO
CHECK GENERATOR PHASE LOCK LOOP (FIGURE 6-4, SHEET 5)

Figure 6-1. Initial Checks

NOTE: Unless otherwise indicated, test points and designators apply to generator (upper) board and mode selector is in generator mode.

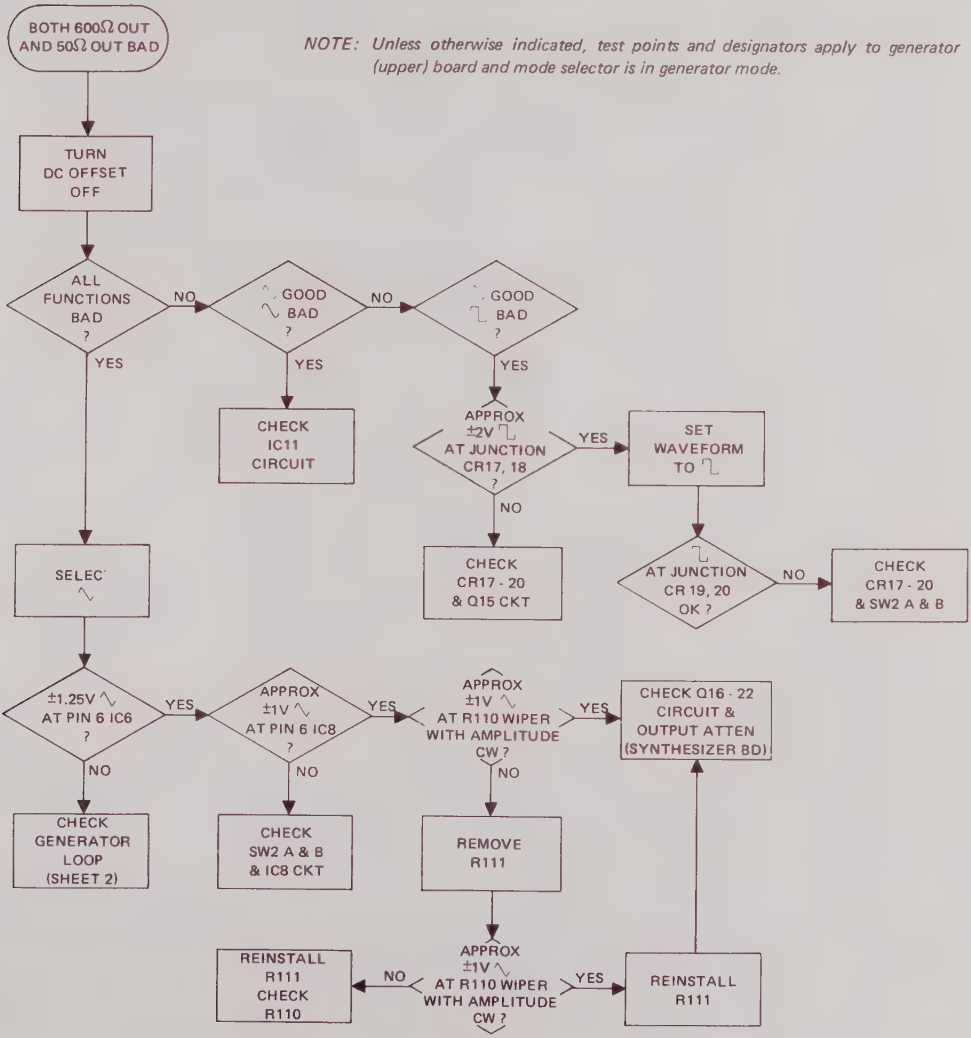
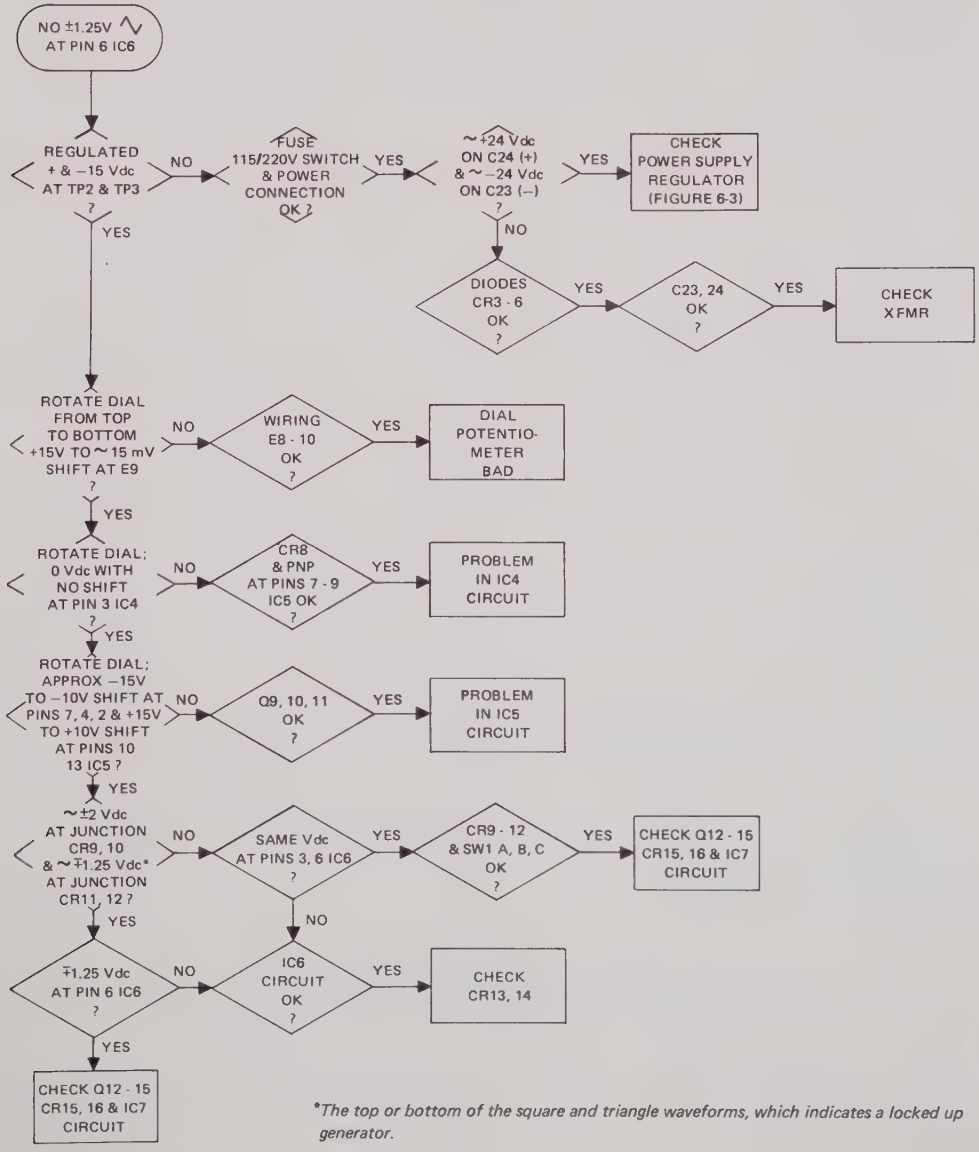
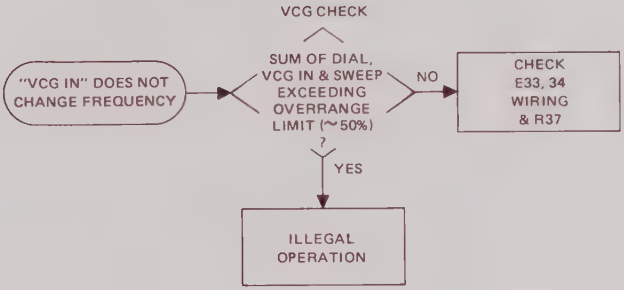


Figure 6-2. Generator Mode Checks (Sheet 1 of 3)


NO ±1.25V ∿ AT PIN 6 IC6
REGULATED + & −15 Vdc AT TP2 & TP3 ?
NO
FUSE 115/220V SWITCH & POWER CONNECTION OK ?
YES
~+24 Vdc ON C24 (+) & ~−24 Vdc ON C23 (−) ?
YES
CHECK POWER SUPPLY REGULATOR (FIGURE 6-3)
NO
DIODES CR3 - 6 OK ?
YES
C23, 24 OK ?
YES
CHECK XFMR
YES
ROTATE DIAL FROM TOP TO BOTTOM +15V TO ~15 mV SHIFT AT E9 ?
NO
WIRING E8 - 10 OK ?
YES
DIAL POTENTIO-METER BAD
YES
ROTATE DIAL; 0 Vdc WITH NO SHIFT AT PIN 3 IC4 ?
NO
CR8 & PNP AT PINS 7 - 9 IC5 OK ?
YES
PROBLEM IN IC4 CIRCUIT
YES
ROTATE DIAL; APPROX −15V TO −10V SHIFT AT PINS 7, 4, 2 & +15V TO +10V SHIFT AT PINS 10 13 IC5 ?
NO
Q9, 10, 11 OK ?
YES
PROBLEM IN IC5 CIRCUIT
YES
~±2 Vdc AT JUNCTION CR9, 10 & ~∓1.25 Vdc* AT JUNCTION CR11, 12 ?
NO
SAME Vdc AT PINS 3, 6 IC6 ?
YES
CR9 - 12 & SW1 A, B, C OK ?
YES
CHECK Q12 - 15 CR15, 16 & IC7 CIRCUIT
NO
IC6 CIRCUIT OK ?
YES
CHECK CR13, 14
YES
∓1.25 Vdc AT PIN 6 IC6 ?
NO
YES
CHECK Q12 - 15 CR15, 16 & IC7 CIRCUIT

**The top or bottom of the square and triangle waveforms, which indicates a locked up generator.*

Figure 6-2. Generator Mode Checks (Sheet 2 of 3)


VCG CHECK
"VCG IN" DOES NOT CHANGE FREQUENCY
SUM OF DIAL, VCG IN & SWEEP EXCEEDING OVERRANGE LIMIT (~50%) ?
NO
CHECK E33, 34 WIRING & R37
YES
ILLEGAL OPERATION

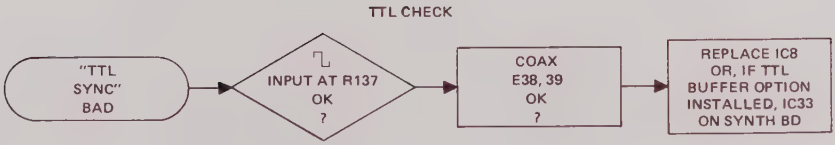


Figure 6-2. Generator Mode Checks (Sheet 3 of 3)

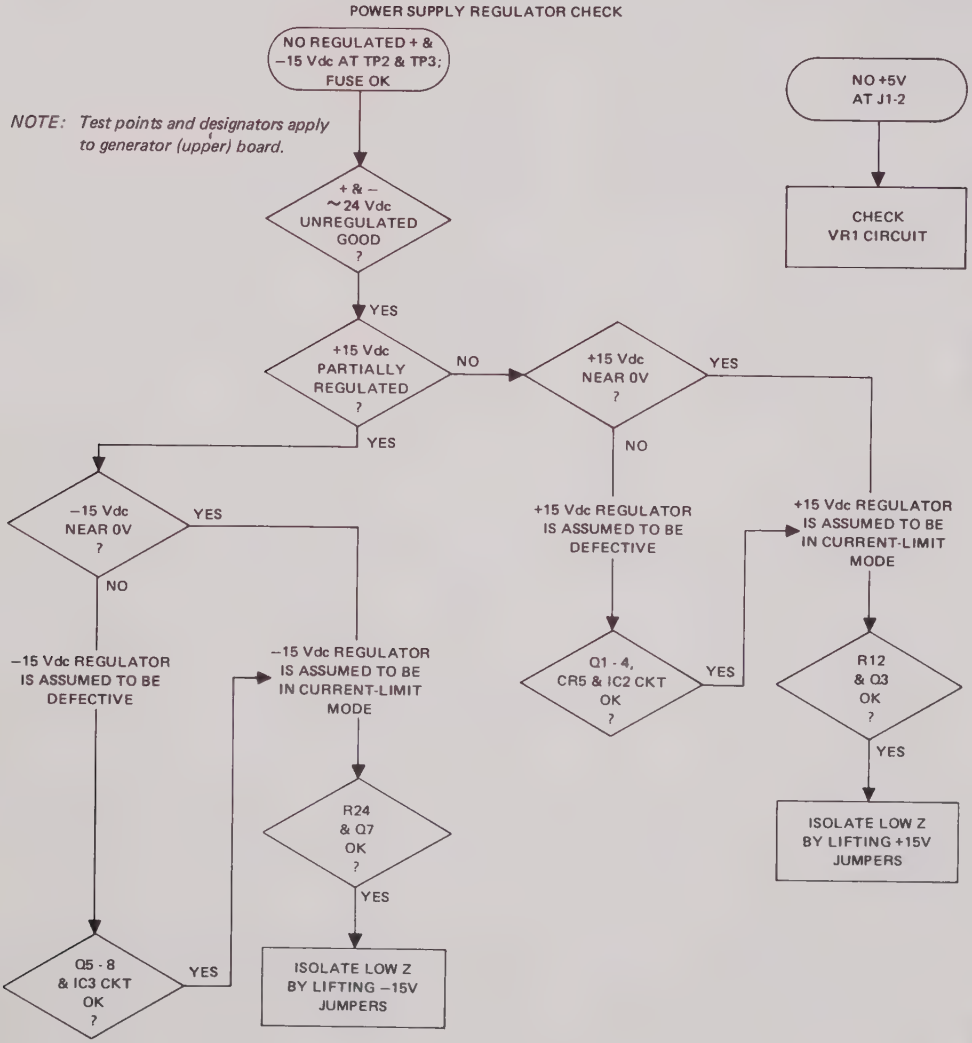

POWER SUPPLY REGULATOR CHECK
NO REGULATED + & −15 Vdc AT TP2 & TP3; FUSE OK
NO +5V AT J1-2
CHECK VR1 CIRCUIT
NOTE: Test points and designators apply to generator (upper) board.
+ & − ~24 Vdc UNREGULATED GOOD ?
YES
+15 Vdc PARTIALLY REGULATED ?
NO
+15 Vdc NEAR 0V ?
YES
NO
YES
−15 Vdc NEAR 0V ?
YES
NO
+15 Vdc REGULATOR IS ASSUMED TO BE DEFECTIVE
+15 Vdc REGULATOR IS ASSUMED TO BE IN CURRENT-LIMIT MODE
Q1 - 4, CR5 & IC2 CKT OK ?
YES
R12 & Q3 OK ?
YES
ISOLATE LOW Z BY LIFTING +15V JUMPERS
−15 Vdc REGULATOR IS ASSUMED TO BE DEFECTIVE
−15 Vdc REGULATOR IS ASSUMED TO BE IN CURRENT-LIMIT MODE
R24 & Q7 OK ?
YES
ISOLATE LOW Z BY LIFTING −15V JUMPERS
Q5 - 8 & IC3 CKT OK ?
YES

Figure 6-3. Power Supply Checks

NOTE: Unless otherwise indicated, test points and designations apply to synthesizer (lower) board and digital switch settings are between 0.1000 and 1.9999.

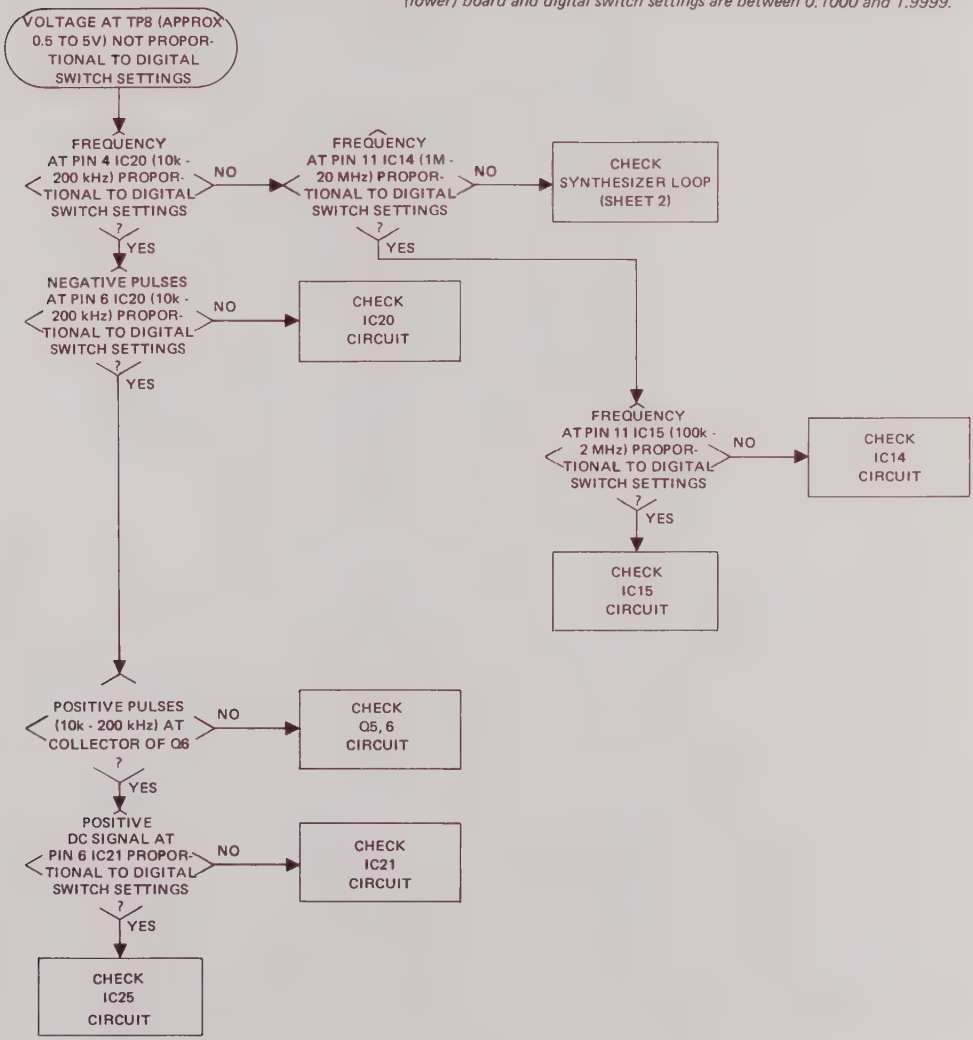

VOLTAGE AT TP8 (APPROX 0.5 TO 5V) NOT PROPORTIONAL TO DIGITAL SWITCH SETTINGS
FREQUENCY AT PIN 4 IC20 (10k - 200 kHz) PROPORTIONAL TO DIGITAL SWITCH SETTINGS
NO
YES
FREQUENCY AT PIN 11 IC14 (1M - 20 MHz) PROPORTIONAL TO DIGITAL SWITCH SETTINGS
NO
YES
CHECK SYNTHESIZER LOOP (SHEET 2)
NEGATIVE PULSES AT PIN 6 IC20 (10k - 200 kHz) PROPORTIONAL TO DIGITAL SWITCH SETTINGS
NO
YES
CHECK IC20 CIRCUIT
FREQUENCY AT PIN 11 IC15 (100k - 2 MHz) PROPORTIONAL TO DIGITAL SWITCH SETTINGS
NO
YES
CHECK IC14 CIRCUIT
CHECK IC15 CIRCUIT
POSITIVE PULSES (10k - 200 kHz) AT COLLECTOR OF Q6
NO
YES
CHECK Q5, 6 CIRCUIT
POSITIVE DC SIGNAL AT PIN 6 IC21 PROPORTIONAL TO DIGITAL SWITCH SETTINGS
NO
YES
CHECK IC21 CIRCUIT
CHECK IC25 CIRCUIT

Figure 6-4. Synthesizer Mode Checks (Sheet 1 of 6)

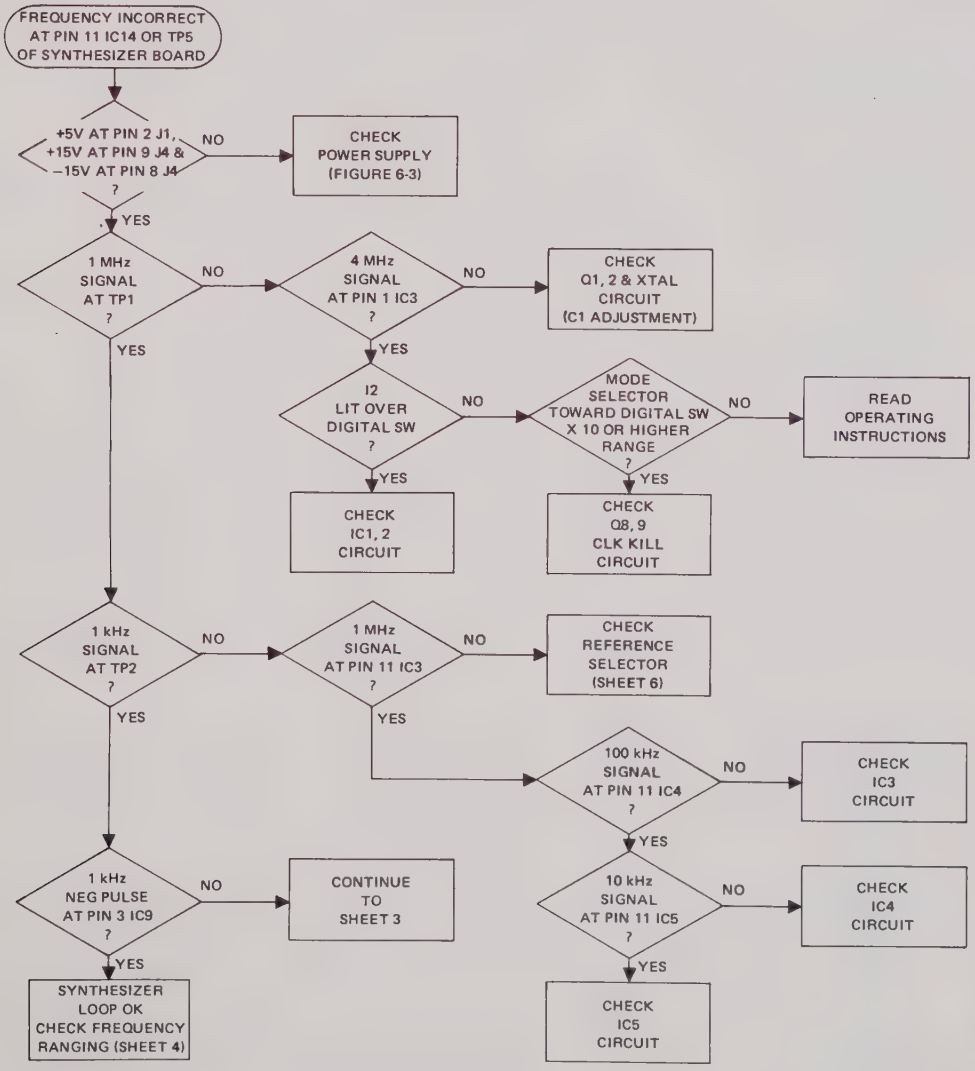

FREQUENCY INCORRECT AT PIN 11 IC14 OR TP5 OF SYNTHESIZER BOARD
+5V AT PIN 2 J1, +15V AT PIN 9 J4 & −15V AT PIN 8 J4 ?
NO
CHECK POWER SUPPLY (FIGURE 6-3)
YES
1 MHz SIGNAL AT TP1 ?
NO
4 MHz SIGNAL AT PIN 1 IC3 ?
NO
CHECK Q1, 2 & XTAL CIRCUIT (C1 ADJUSTMENT)
YES
I2 LIT OVER DIGITAL SW ?
NO
MODE SELECTOR TOWARD DIGITAL SW X 10 OR HIGHER RANGE ?
NO
READ OPERATING INSTRUCTIONS
YES
CHECK IC1, 2 CIRCUIT
YES
CHECK Q8, 9 CLK KILL CIRCUIT
YES
1 kHz SIGNAL AT TP2 ?
NO
1 MHz SIGNAL AT PIN 11 IC3 ?
NO
CHECK REFERENCE SELECTOR (SHEET 6)
YES
100 kHz SIGNAL AT PIN 11 IC4 ?
NO
CHECK IC3 CIRCUIT
YES
1 kHz NEG PULSE AT PIN 3 IC9 ?
NO
CONTINUE TO SHEET 3
10 kHz SIGNAL AT PIN 11 IC5 ?
NO
CHECK IC4 CIRCUIT
YES
SYNTHESIZER LOOP OK CHECK FREQUENCY RANGING (SHEET 4)
YES
CHECK IC5 CIRCUIT

Figure 6-4. Synthesizer Mode Checks (Sheet 2 of 6)

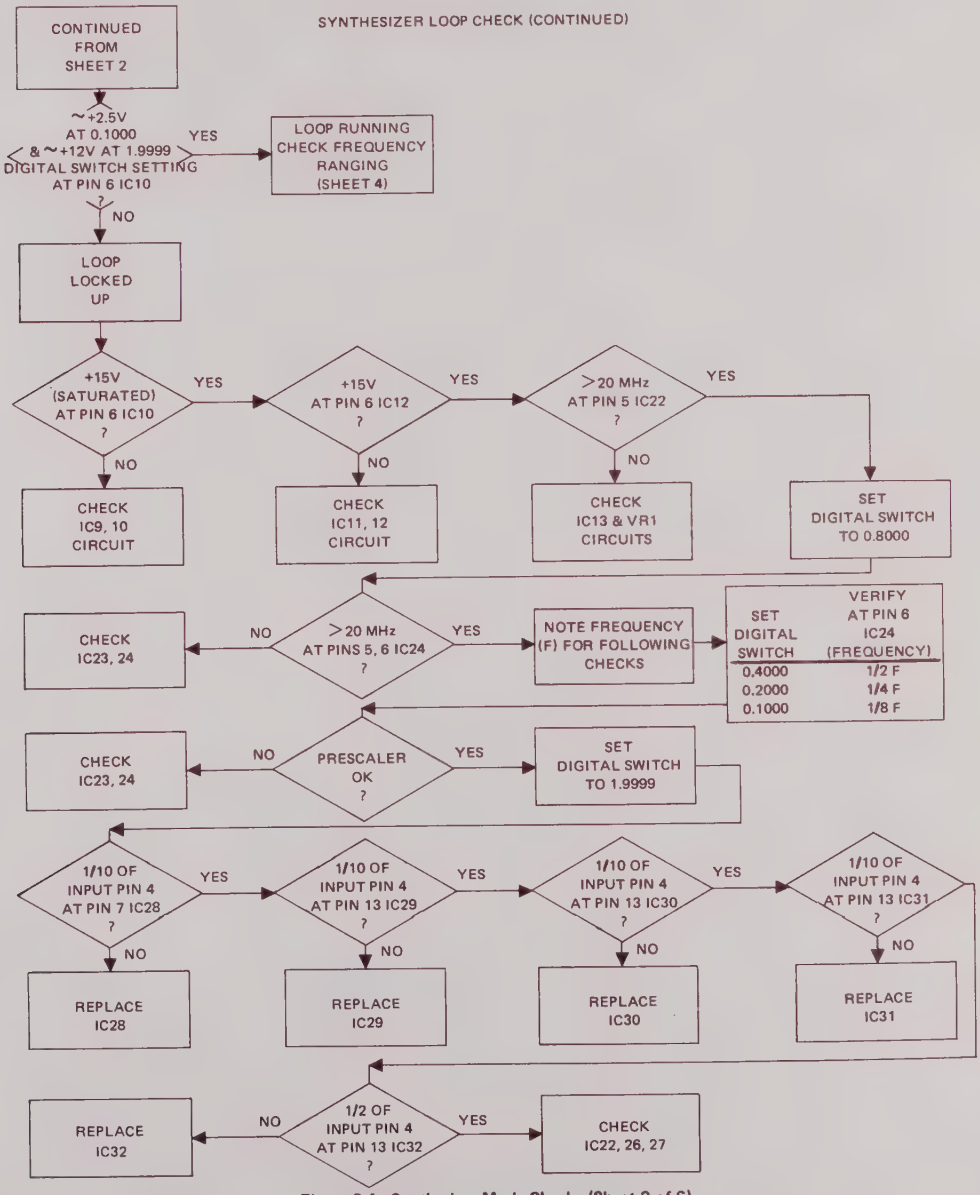


Figure 6-4. Synthesizer Mode Checks (Sheet 3 of 6)

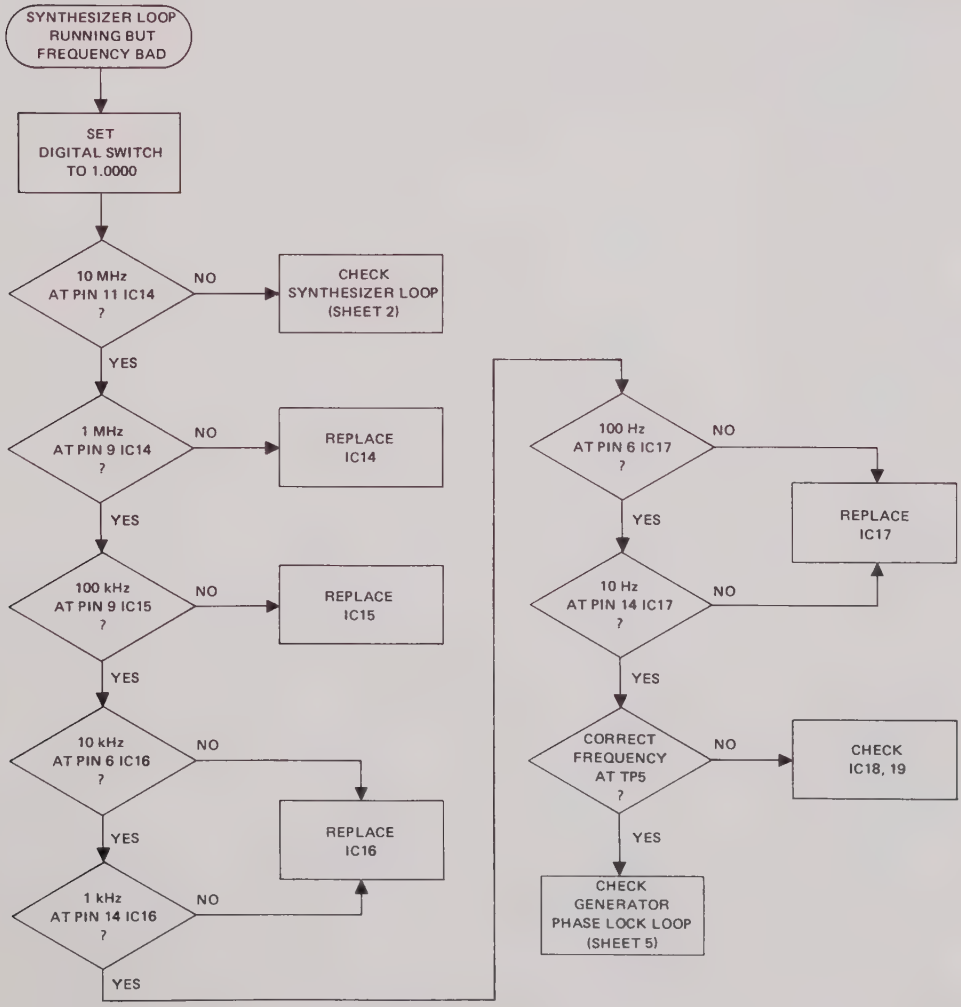


Figure 6-4. Synthesizer Mode Checks (Sheet 4 of 6)

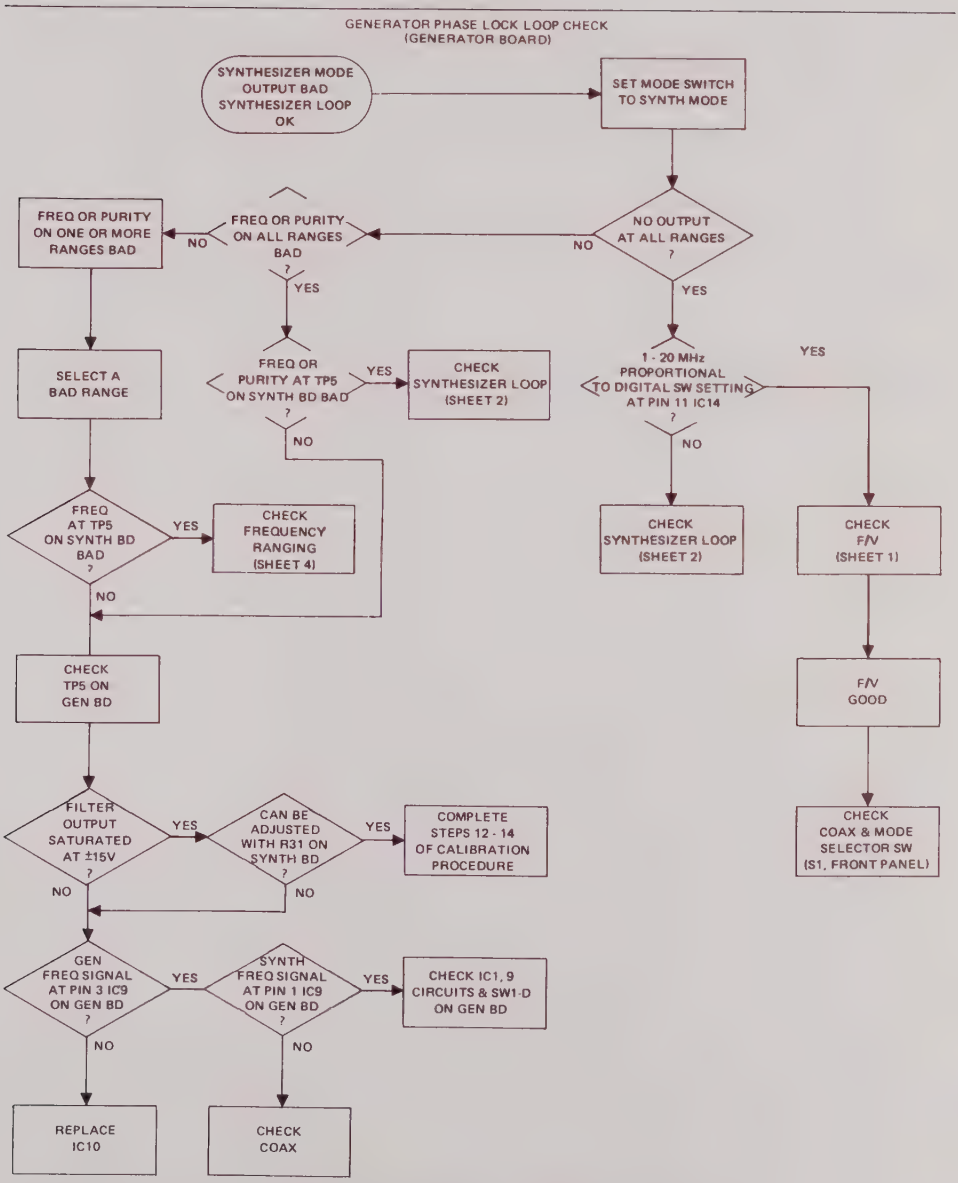

GENERATOR PHASE LOCK LOOP CHECK
(GENERATOR BOARD)
SYNTHESIZER MODE OUTPUT BAD SYNTHESIZER LOOP OK
SET MODE SWITCH TO SYNTH MODE
NO OUTPUT AT ALL RANGES ?
NO
YES
FREQ OR PURITY ON ALL RANGES BAD ?
NO
YES
FREQ OR PURITY ON ONE OR MORE RANGES BAD
SELECT A BAD RANGE
FREQ OR PURITY AT TP5 ON SYNTH BD BAD ?
YES
CHECK SYNTHESIZER LOOP (SHEET 2)
NO
1 - 20 MHz PROPORTIONAL TO DIGITAL SW SETTING AT PIN 11 IC14 ?
YES
NO
CHECK SYNTHESIZER LOOP (SHEET 2)
CHECK F/V (SHEET 1)
FREQ AT TP5 ON SYNTH BD BAD ?
YES
CHECK FREQUENCY RANGING (SHEET 4)
NO
CHECK TP5 ON GEN BD
F/V GOOD
CHECK COAX & MODE SELECTOR SW (S1, FRONT PANEL)
FILTER OUTPUT SATURATED AT ±15V ?
YES
CAN BE ADJUSTED WITH R31 ON SYNTH BD ?
YES
COMPLETE STEPS 12 - 14 OF CALIBRATION PROCEDURE
NO
NO
GEN FREQ SIGNAL AT PIN 3 IC9 ON GEN BD ?
YES
SYNTH FREQ SIGNAL AT PIN 1 IC9 ON GEN BD ?
YES
CHECK IC1, 9 CIRCUITS & SW1-D ON GEN BD
NO
NO
REPLACE IC10
CHECK COAX

Figure 6-4. Synthesizer Mode Checks (Sheet 5 of 6)

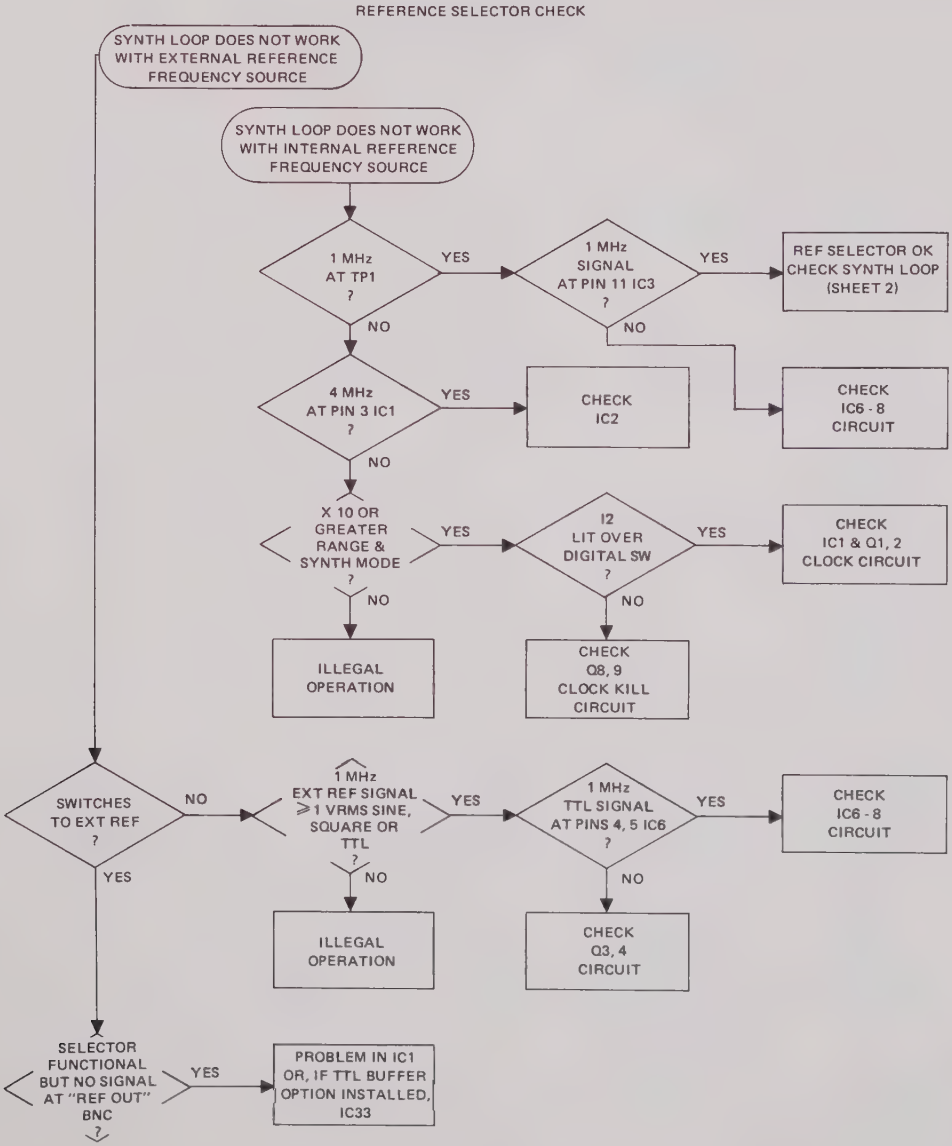

REFERENCE SELECTOR CHECK
SYNTH LOOP DOES NOT WORK WITH EXTERNAL REFERENCE FREQUENCY SOURCE
SYNTH LOOP DOES NOT WORK WITH INTERNAL REFERENCE FREQUENCY SOURCE
1 MHz AT TP1 ?
YES
1 MHz SIGNAL AT PIN 11 IC3 ?
YES
REF SELECTOR OK CHECK SYNTH LOOP (SHEET 2)
NO
NO
4 MHz AT PIN 3 IC1 ?
YES
CHECK IC2
CHECK IC6 - 8 CIRCUIT
NO
X 10 OR GREATER RANGE & SYNTH MODE ?
YES
I2 LIT OVER DIGITAL SW ?
YES
CHECK IC1 & Q1, 2 CLOCK CIRCUIT
NO
NO
ILLEGAL OPERATION
CHECK Q8, 9 CLOCK KILL CIRCUIT
SWITCHES TO EXT REF ?
NO
1 MHz EXT REF SIGNAL ≥ 1 VRMS SINE, SQUARE OR TTL ?
YES
1 MHz TTL SIGNAL AT PINS 4, 5 IC6 ?
YES
CHECK IC6 - 8 CIRCUIT
YES
NO
NO
ILLEGAL OPERATION
CHECK Q3, 4 CIRCUIT
SELECTOR FUNCTIONAL BUT NO SIGNAL AT "REF OUT" BNC ?
YES
PROBLEM IN IC1 OR, IF TTL BUFFER OPTION INSTALLED, IC33

Figure 6-4. Synthesizer Mode Checks (Sheet 6 of 6)

SECTION 7
PARTS AND SCHEMATICS

7.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

7.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit and, if applicable, the function performed.

7.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

	Page No.
CHASSIS	
Assembly Drawing	7-2
Schematic	7-3
Parts List	7-4
MAIN BOARD	
Assembly Drawing	7-6
Schematic	7-7
Parts List	7-8
SYNTHESIZER BOARD	
Assembly Drawing	7-10
Schematic	7-11
Parts List	7-12

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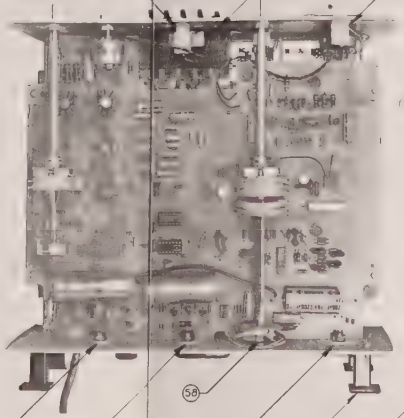
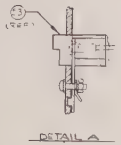
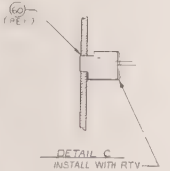
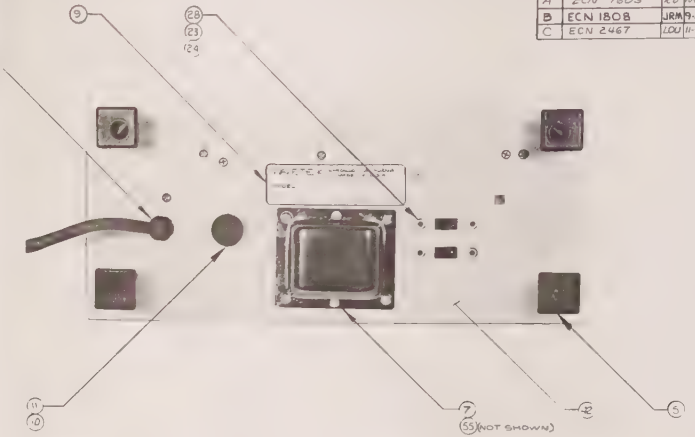
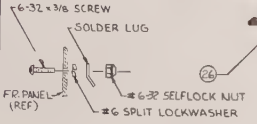
REV	ECN	BY	DATE	APP
A	ECN 1603	RO	6-83	
B	ECN 1808	JRM	9-86	
C	ECN 2467	LDU	11-88	





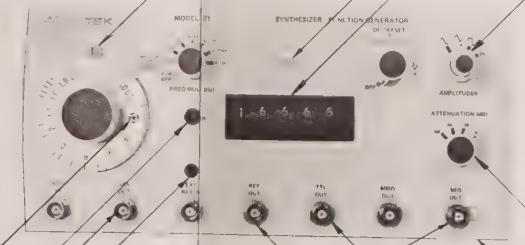


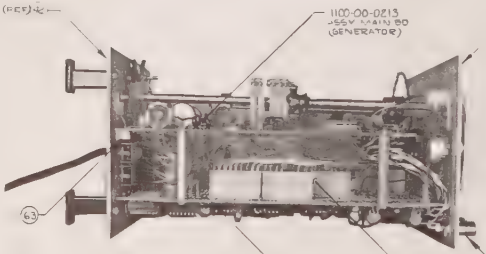


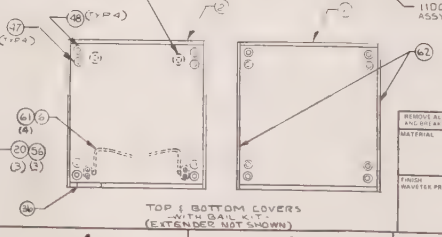


DETAIL B
HARDWARE STACK UP FOR GROUND LUG (TYP 3 PLACES)

NOTE: ALL CONNECTIONS TO BE MECHANICALLY SECURE TO LUGS PRIOR TO SOLDERING GROUND WIRES.

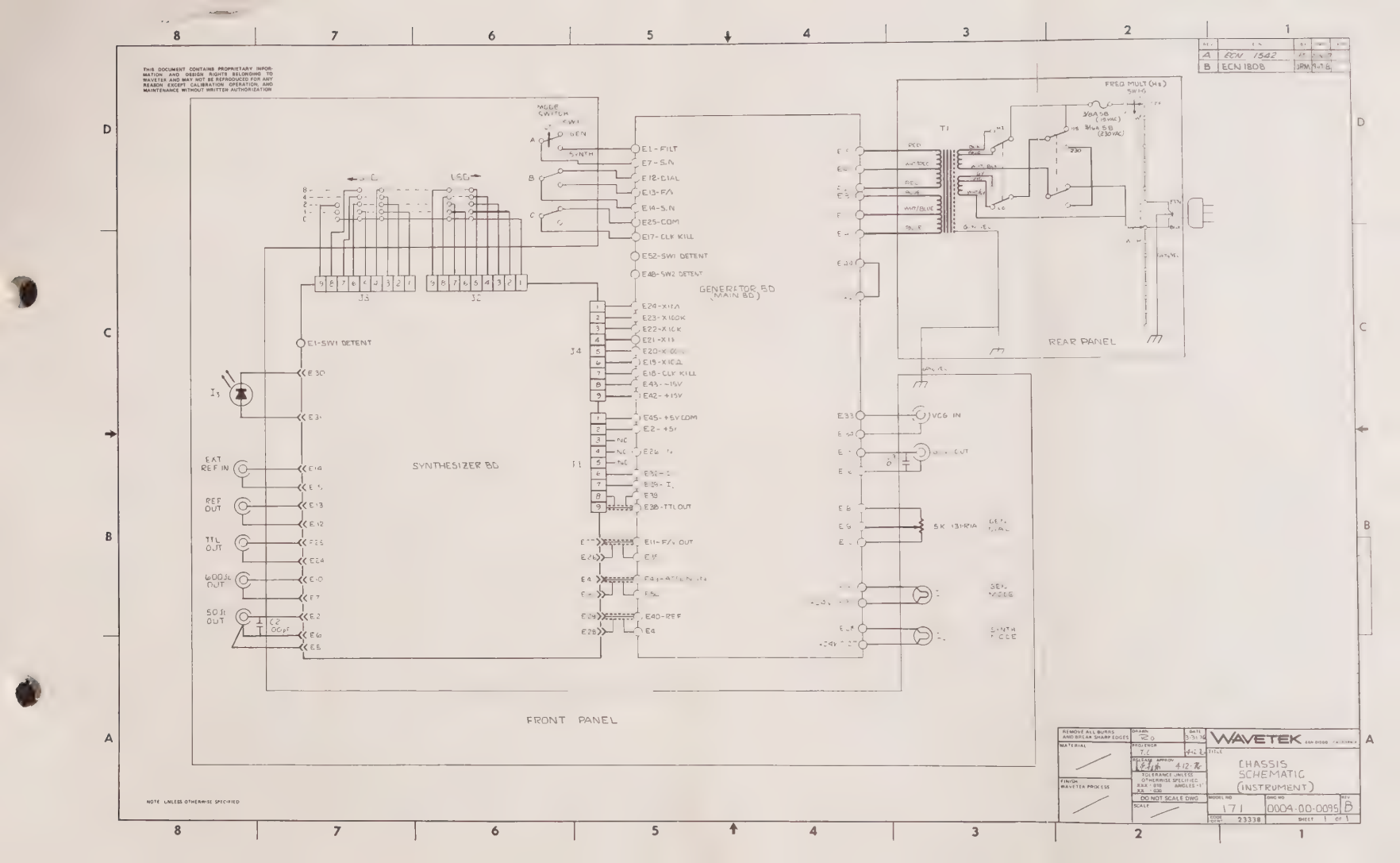






NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN RO	DATE 7/13/76	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PRODUCTION P.O.	4/4/76	TITLE ASSEMBLY CHASSIS
FINISH WAVETEK PROCESS	ENGR Lesk	4/2/76	
	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ± .010 ANGLES ± .5°		
	DO NOT SCALE DWG	MODEL NO 171	DRG NO 0101-00-0510 REV C
	SCALE	CODE IDENT 23338	SHEET 1 OF 1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REV
A ECN 1542
B ECN 1808
MODE SWITCH SW1
GEN
SYNTH
E1 - FILT
E7 - S.W
E12 - DIAL
E13 - F/A
E14 - S.W
E25 - COM
E17 - CLK KILL
E52 - SW1 DETENT
E48 - SW2 DETENT
MSD
LSD
J3
J2
GENERATOR BD (MAIN BD)
J4
E24 - X1M
E23 - X100K
E22 - X10K
E21 - X1K
E20 - X100
E19 - X10Ω
E18 - CLK KILL
E49 - -15V
E42 - +15V
E45 - +5V COM
E2 - +5V
E26
E32
E39
E38 - TTL OUT
E11 - F/A OUT
E40 - REF
E4
E1 - SW1 DETENT
E30
E31
SYNTHESIZER BD
EXT REF IN
REF OUT
TTL OUT
600Ω OUT
50Ω OUT
C2 .001μF
E33 - VCG IN
5K 13-TURN
SET MODE
SYNTH FREQ
FREQ MULT (Hz) SW16
T1
115 VAC 5B (115VAC)
230 VAC 5B (230VAC)
230
REAR PANEL
FRONT PANEL
NOTE UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN TC
PROJ ENGR TC
RELEASE APPROV
TOLERANCE UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DWG
SCALE
DATE 5-31-90
WAVETEK SAN DIEGO, CALIFORNIA
TITLE
CHASSIS SCHEMATIC (INSTRUMENT)
MODEL NO 171
DWG NO 0009-00-0095
REV B
CODE IDENT NO 23338
SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. CHASSIS	0102-00-0510	WVTK	0102-00-0510	1
NONE	DIAL ASSY	180-027	WVTK	1201-00-0027	1
59	TRANSFORMER	171-486	WVTK	1704-00-0486	1
7	END BELL	110-333	WVTK	1400-00-0174	1
43	SPACER	8480	WVTK	1400-00-0452	2
NONE	PLATE, NAME	129-309	WVTK	1400-00-2180	1
53	INDICATOR, DIAL	180-303	WVTK	1400-00-4970	1
NONE	COVER, TOP	180-300-1	WVTK	1400-00-5000	1
62	EXPANDER	180-301	WVTK	1400-00-5010	2
5	POST	180-302	WVTK	1400-00-5020	4
NONE	COVER, BOTTOM	180-300-2	WVTK	1400-00-5030	1
57	CORD HOLDER	1400-00-5409	WVTK	1400-00-5409	1
41	PANEL, FT	1400-00-5740	WVTK	1400-00-5740	1
42	PANEL, REAR, ANO	1400-00-5753	WVTK	1400-00-5753	1
60	INDICATOR FROM 1400-00-4970	1400-00-5769	WVTK	1400-00-5769	1
9	I.D. LABEL	1400-00-9110	WVTK	1400-00-9110	1
C2	CAP, CER, 1000PF, 1KV	DD-101	CRL	1500-01-0111	1

WAVETEK PARTS LIST | TITLE: CHASSIS | ASSEMBLY NO. 1101-00-0510 | PAGE 1 | REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C3	CAP, CER, MN. .01MF, 50V	CACD2I5U103Z1(0A	CORNO	1500-01-0310	1
16	BNC CONN	KC-7946	KING	2100-01-0002	7
30	CONN, 9PIN	09-50-7091	MOLEX	2100-02-0031	4
19	SOLDER LUG	1497	SMITH	2100-04-0012	7
NONE	SOLDER LUG	1485-6	SMITH	2100-04-0025	3
31	PIN	08-50-0103	MOLEX	2100-05-0025	34
20	STD KNOB	RB-47-1-SB-M	ROGAN	2400-01-0008	2
21	COAX KNOB SET	RB-67-1-SB+0-1-9	ROGAN	2400-01-0009	1
13	LAMP	7874	JKL	2400-02-0013	2
10	FUSE, 3/8A, 250V, S-B	313.375	LITFU	2400-05-0009	1
11	FUSE HOLD	031.1653/031.1646	SCHUR	2400-05-0012	1
36	BUSHING NYLINER	4L2FF	THOMN	2800-01-0002	4
47	STANDOFF, MALE/FEMALE .750 H., .250 HEX, 4-40	1443-M03-F05-440	UNICP	2800-02-0009	4
48	STANDOFF, MALE/FEMALE 1.750 H., .250 HEX 8-32	1473-M03-F03-832	UNICP	2800-02-0010	4
NONE	RAIL ASSY W/FT	180-500	WVTK	2800-08-0010	1

WAVETEK PARTS LIST | TITLE: CHASSIS | ASSEMBLY NO. 1101-00-0510 | PAGE 2 | REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SPEEDNUT, SELF RETAIN	C7496-632-4	TINN	2800-09-0003	6
14	FAST. CHASSIS	1591-C11	USECO	2800-09-0022	2
18	WASHER, SHOULDER	2668	SMITH	2000-27-0004	14
12	STRAIN RELIEF BUSH	SR6M-1	HEYCO	2800-37-0003	1
39	FERRITE BEAD	56-590-65/3B	FERRI	3100-00-0001	1
40	LED	TIL-220	TI	4899-00-0006	1
58	WAFER FROM 5104-02-0007	5104-98-0001	WVTK	5104-98-0001	2
28	SW ASSY SLIDE HI-LO	SM422-FT-MK	UID	3103-00-0001	1
23	SWITCH ASSY SLIDE	46236-LF	SWCFT	3103-00-0002	1
24	SOLDER GUARD	46236-LF-SG	SWCFT	3103-09-0001	2
45	SWITCH TOGGLE	7301P3D2N	C&K	3106-00-0018	1
46	SWITCH	2B-W-62-C	DIGTN	3107-00-0006	1
29	PWR CORD	0-7789-008-8Y	PACRD	6001-80-0004	1

WAVETEK PARTS LIST | TITLE: CHASSIS | ASSEMBLY NO. 1101-00-0510 | PAGE 3 | REV E

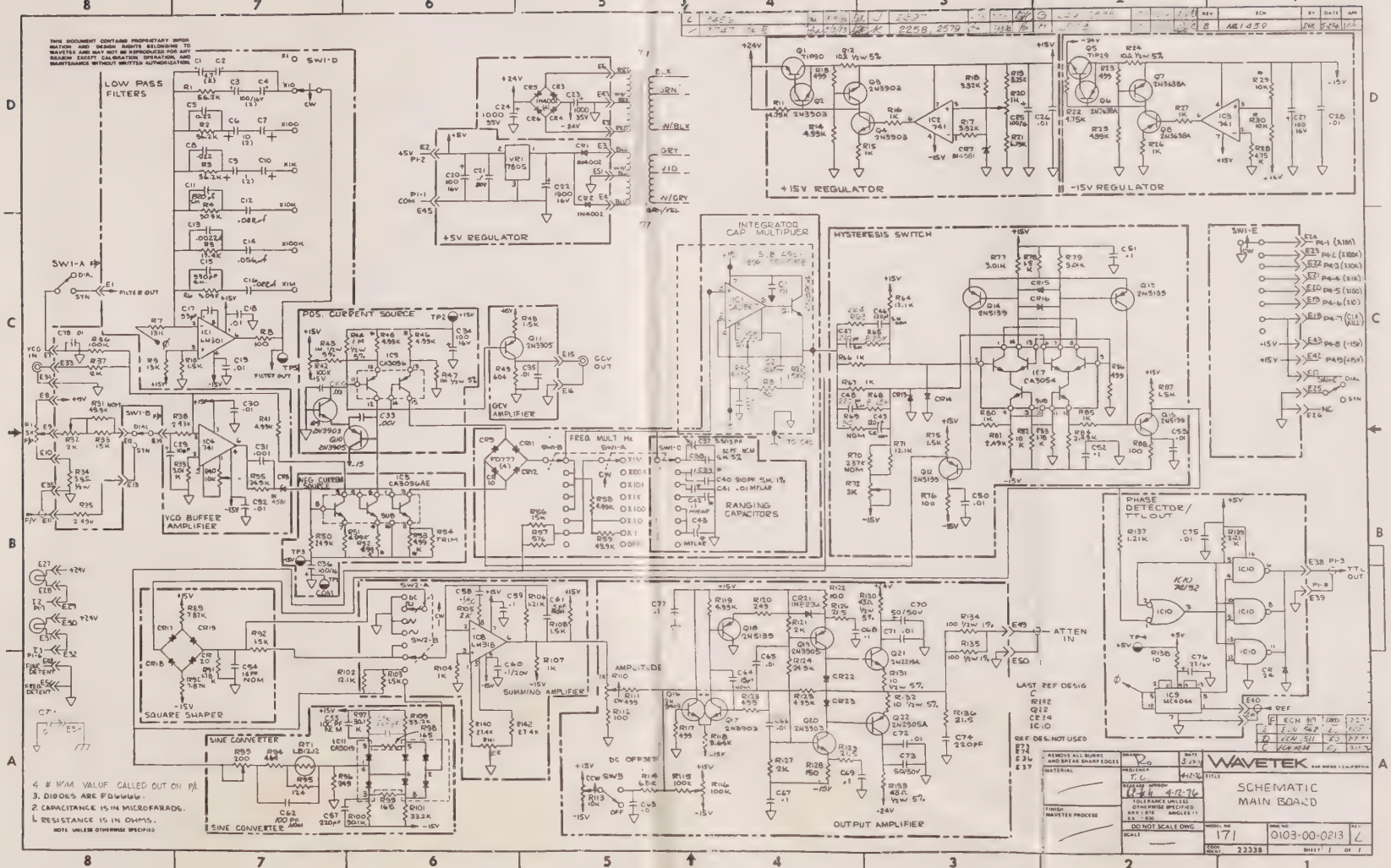
REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DRAWN | DATE | PROJ ENGR | RELEASE APPROV | TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.02 | DO NOT SCALE DWG | SCALE

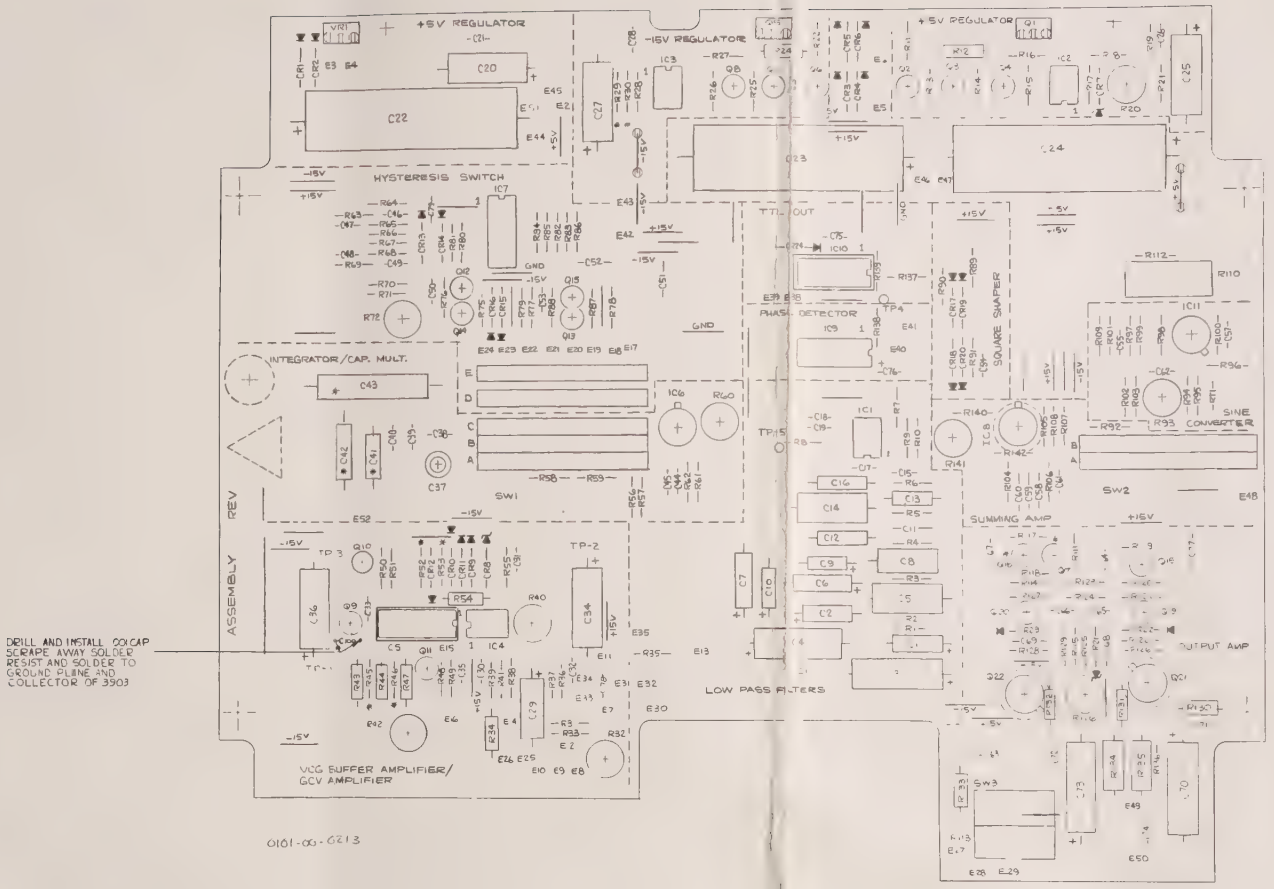
WAVETEK SAN DIEGO, CA, U.S.A.

PARTS LIST
CHASSIS

MODEL NO. 171 | DWG NO. 1101-00-0510 | REV E | USED | QTY 23338 | SHEET 1 OF 1

NOTE: UNLESS OTHERWISE SPECIFIED


LOW PASS FILTERS
+5V REGULATOR
+15V REGULATOR
-15V REGULATOR
INTEGRATOR CAP MULTIPLIER
HYSTERESIS SWITCH
POS CURRENT SOURCE
NEG CURRENT SOURCE
VCG BUFFER AMPLIFIER
VCO AMPLIFIER
FREQ MULT Hz
RANGING CAPACITORS
PHASE DETECTOR / TTL OUT
SQUARE SHAPER
SINE CONVERTER
SUMMING AMPLIFIER
AMPLITUDE
DC OFFSET
OUTPUT AMPLIFIER
ATTEN IN
SCHEMATIC
MAIN BOARD
WAVETEK
0103-00-0213



REV	ECN	BY	DATE	APPR
B	ECN 1521	RD	2/8/77	
C	ECN 1911	KLD	7/7/77	
D	" "	"	10/7/77	
E	2593	LCU 2 & 81	4/4/78	

MAIN BD
MODEL 171

SHEET 1 OF 2
(SHEET 3 IS "D" SIZE)

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	ASSY DRWG MAIN	0101-00-0213	WVTK	0101-00-0213	1
NONE	SCHEMATIC, MAIN	0103-00-0213	WVTK	0103-00-0213	1
NONE	QA DRWG MAIN			0107-00-0213	1
A6C	PCA P190YBACK BOARD	171-0908	WVTK	1200 00 0908	1
1	SPACER	8480	WVTK	1450-00 0653	4
NONE	PLATE SM	008-004	WVTK	1400-00 2130	2
C611	CAP,CER,.SPF,1KV	DD-050	CRL	1500-00-3011	1
C100- C31 C33	CAP,CER,.001MF 1KV	DD-102	CRL	1500-01-0211	3
C79	CAP,CER ,.01MF,1KV	DAP-103	CRL	1500-01-0309	1
C18 C19 C26 C28 C30 C32 C33 C50 C53 C63 C63 C66 C71 C72 C73 C78	CAP,CER MN ,.01MF,50V	CAC0275U1037100A	CORNG	1500-01-0310	16
C21 C51 C52 C58 C59 C60 C67 C68 C69 C77	CAP,CER,MON ,.1MF,50V	CAC0275U1042030A	CORNG	1500-01-0403	10
C547 C647	CAP CER 15PF,1KV	DD-150	CRL	1500-01-5011	2
C57 C74	CAP,CER ,220PF 1KV	DD-221	CRL	1500-02-2111	2
C17	CAP,CER ,33PF 1KV	DD-330	CRL	1500 03-3011	1
C36	CAP,CER,.330PF,1KV	DD-331	CRL	1500-03-3111	1
C621	CAP CER 82PF,1KV	DD-820	CRL	1500-08-2011	1

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0213 — PAGE 1 — REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C29 C6 C7	CAP TANT 10MF 20V	150D106X9020B2	SPRAG	1500-71-0601	3
C76	CAP TANT 22MF 20V	202A2002226M3	MATSO	1500-72-2621	1
C1 C2	CAP TANT 4.7MF 35V	150D475X9035B2	SPRAG	1500-74-7302	2
	CAP SET POLYC MIXED MATCHED SET	180-501	WVTK	1509-80-0008	1
C41	CAP POLYC ,01MF 100V PART OF 1509-80-0008 QTY:11				
C42	CAP POLYC ,1MF 100V PART OF 1509-80-0008 QTY:11				
C43	CAP POLYC 1MF 100V PART OF 1509-80-0008 QTY:11				
NONE	MAIN	1700-00-0213	WVTK	1700-00-0213	1
J	SKT IC,14 PIN	DIL814P/108	BURNC	2100-03-0066	1
J	SKT IC 16 PIN	DIL816P 108	BURNC	2100-03-0067	1
NONE	SOLDER LUG	1497	SMITH	2100-04-0012	2
4	TERM	20008	USECC	2106-03-0009	43
NONE	TERM	20108	USECC	2100-03-0011	1
3	PIN MALE	61182-2	AMP	2100-03-0020	2

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0213 — PAGE 3 — REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR PART-NO	MFGR	WAVETEK NO	QTY/PT
R27 R66 R67 R80 R83					
R82	RES MF 1/8W,1% 10K	RN55D 1002F	TRW	4701-03-1002	1
R115 R36	RES MF,1/8W,1% 100K	RN55D-1003F	TRW	4701-03-1003	4
R138	RES MF,1/8W,1% 10	RN55D-10R0F	TRW	4701-03-1009	1
R106 R137	RES MF,1/8W,1% 1.21K	RN55D-1211F	TRW	4701-03-1211	2
R102 R64 R71	RES MF,1/8W,1% 12.1K	RN55D-1212F	TRW	4701-03-1212	3
R95	RES MF,1/8W,1% 124	RN55D-1240F	TRW	4701-03-1240	1
R7 R9	RES MF,1/8W,1% 13K	RN55D-1302F	TRW	4701-03-1302	2
R120	RES MF,1/8W,1% 130	RN55D-1300F	TRW	4701-03-1300	1
R10 R103 R108 R40 R75 R78 R87 R92	RES MF,1/8W,1% 1.5K	RN55D-1501F	TRW	4701-03-1501	8
R33 R36	RES MF,1/8W,1% 13K	RN55D-1302F	TRW	4701-03-1302	2
R98 R99	RES MF,1/8W,1% 165	RN55D-1650F	TRW	4701-03-1650	2
R5	RES MF 1/8W,1% 17.4K	RN55D-1742F	TRW	4701-03-1742	1
R83 R91	RES MF,1/8W,1% 1.78K	RN55D-1781F	TRW	4701-03-1781	2
R105 R121 R127 R37	RES MF,1/8W,1% 2K	RN55D-2001F	TRW	4701-03-2001	4
R126 R129 R136	RES MF,1/8W,1% 21.5	RN55D-21R5F	TRW	4701-03-2159	3
R139	RES MF,1/8W,1% 2.21K	RN55D-2211F	TRW	4701-03 2211	1

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0213 — PAGE 5 — REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR PART NO	MFGR	WAVETEK NO	QTY/PT
C46T C49T	CAP MICA,120PF 300V	DM15-121J	ARCO	1500-11 2100	2
C47 C48	CAP MICA 220PF 300V	DM19 221J	ARCO	1500-12 2100	2
C13	CAP MICA 330PF 300V	DM19 331J	ARCO	1500 13-3100	1
C39T	CAP,MICA,68PF 500V	DM15 680J	ARCO	1500 16-8000	1
C98T	CAP MICA,82PF 500V	DM15-820J	ARCO	1500-18 2000	1
C11	CAP MICA,820PF,300V	DM15 821F	ARCO	1500 18-2101	1
C40	CAP 910PF,100V,1%	DM15-911F	ARCO	1500-19-1101	1
C2T C25 C27 C3 C34 C3a C4	CAP ELECT 100MF,16V	30D107C016DC7	SPRAG	1200-31 0101	7
C23 C24	CAP ELECT.1000MF 35V	39D108G035CL6	SPRAG	1500-31 0212	2
C22	CAP ELECT.1900MF 15V	39D198G015CL4	SPRAG	1500 31-9201	1
C70 C73	CAP ELECT 50MF 50V	30D506G050DD7	SPRAG	1500-35-0003	2
C13	POLYC,.0022MF 200V	192P22292	SPRAG	1500-42-2204	1
C12 C16 C8	POLYE,.022MF 200V	192P22392	SPRAG	1500-42-2304	1
C5	CAP,POLYE ,.22MF 80V	192P22498	SPRAG	1500-42 2403	1
C14	POLY,.056MF 200V	192P56392	SPRAG	1500-45-6304	1
C37	VARI,3.5-13PF 250V	75-TRIMD-02 3.5/13PF	TRIMD	1500-51-3000	1
C10 C9	CAP TANT 1MF 35V	150D105X9035A2	SPRAG	1500-71-0502	2

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0213 — PAGE 2 — REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
E	STANDOFF .5% + .25, -.MFI 4 40	P 809-M03-F05-440	WVTK	2000-02-0016	4
Y	HOLT 6MHz	207	MARE	2800-11-0001	1
Q	TRANSIPAD	10160	MOTRO	2800-11-0004	2
R [illegible]	POT CONT 1K	180-401	WVTK	4600-01-0207	1
R2	POT TRIM 1K	91AR1K	BECK	4600-01-0209	1
R46	POT TRIM 2K	91AR10K	BECK	4600-01-0315	1
R116 R42	POT TRIM 100K	91AR100K	BECK	4600-01-0402	2
R82	POT TRIM 200	91AR200	BECK	4600-02-0101	1
R141 R32 R72	POT TRIM 2K	91AR2K	BECK	4600-02-0201	3
R113	POT SWITCH 10K	4602-01-0300	WITX	4602-01-0300	1
R12 R131 R132 R24	RES C 1/2W 5% 10	RC20GF-100	STKP	4700 23 0100	4
R3-	RES C 1/2W 5% 3.9	RC20GF-3R9	STKP	4700-25-0399	1
R130 R133	RES C 1/2W 5% 43	RC20GF-430	STKP	4700-25-0430	2
R43 R44 R47	RES C 1/2W 5% 1M	RC20GF-105	STKP	4700-25-1004	3
R112 R122 R76 R8 R85	RES MF 1/8W 1% 100	RN55D-1000F	TRW	4701-03-1000	5
R104 R107 R13 R16 R24	RES MF 1/8W 1% 1K	RN55D-1001F	TRW	4701-03-1001	16

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0213 — PAGE 4 — REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
R70	RES MF 1/8W,1% 237K	RN55D-2373F	TRW	4701-03-2373	1
R120 R96	RES MF,1/8W,1% 249	RN55D-2490F	TRW	4701-03-2490	2
R35 R38 R81 R84	RES MF,1/8W,1% 2.49K	RN55D-2491F	TRW	4701-03-2491	4
R124 R50 R55	RES MF 1/8W,1% 24.9K	RN55D-2492F	TRW	4701-03 2492	3
R63T	RES MF 1/8W,1% 274	RN55D-2740F	TRW	4 01-03-2740	1
R140 R142	RES MF,1/8W,1% 27.4K	RN55D-2742F	TRW	4701-03 2742	2
R69T	RES MF,1/8W,1% 301	RN55D-3010F	TRW	4701-03-3010	1
R39 R77 R79	RES MF,1/8W,1% 3.01K	RN55D-3011F	TRW	4701 03 3011	3
R100 R97	RES MF 1/8W,1% 30.1K	RN55D-3012F	TRW	4701-03 3012	2
R18	RES MF 1/8W,1% 3.32K	RN55D-3321F	TRW	4701 03 3321	1
P101 R109	RES MF 1/8W,1% 33.2K	RN55D-3322F	TRW	4701-03 3322	2
R119	RES MF,1/8W,1% 3.65K	RN55D-3651F	TRW	4701-03-3651	1
R17	RES MF 1/8W,1% 3.92K	RN55D 3921F	TRW	4701 03 3921	1
R94	RES MF,1/8W,1% 464	RN55D 4640F	TRW	4701-03-4640	1
R11 R22 R28	RES MF,1/8W 1% 4.75K	RN55D-4751F	TRW	4 01-03-475.	3
R111 R117 R123 R13 R23 R86	RES MF,1/8,1% 499	RN55D-4990F	TRW	4 01-03 4990	6
R119 R125 R14 R25 R41	RES MF 1/8W 1% 4.99K	RN55D-4991F	TRW	4701-03-4991	5

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0213 — PAGE 6 — REV Q

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CA
MATERIAL	ENGINEER		TITLE: PARTS LIST MAIN
FINISH: WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ±.010 ANGLES ± 1, XX ±.030		MODEL NO: 171 — DWG NO: 1100-00-0213 — REV: Q
DO NOT SCALE DWG	SCALE		CODE IDENT: 23338 — SHEET 1 OF 2

©WAVETEK GRAPHICS, SCOTTSMEN PRODUCED NO. A-3864

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R51 R56					
R317 R39	RES.MF.1/8W.1%.49.9K	RN55D-4992F	TRW	4701-03-4992	2
R1 R2 R3	RES.MF.1/8W.1%.36.2K	RN55D-3622F	TRW	4701-03-3622	3
R37	RES.MF.1/8W.1%.576	RN55D 5760F	TRW	4701-03-5760	1
R49	RES.MF.1/8W.1%.604	RN55D-6040F	TRW	4701-03-6040	1
R21	RES.MF.1/8W.1%.6.19K	RN55D-6191F	TRW	4701-03-6191	1
R114	RES.MF.1/8W.1%.6.81K	RN55D 6811F	TRW	4701-03-6811	1
R89 R90	RES.MF.1/8W.1%.7.87K	RN55D-7871F	TRW	4701-03-7871	2
R19 R43 R48	RES.MF.1/8W.1%.8.25K	RN55D-8251F	TRW	4701-03-8251	3
R6	RES.MF.1/8W.1%.9.09K	RN55D-9091F	TRW	4701-03-9091	1
R4	RES.MF.1/8W.1%.90.9K	RN55D-9092F	TRW	4701-03-9092	1
R134 R135	RES.MF.1/2W.1%.100	RN65D-1000F	TRW	4701-23-1000	2
R29 R30	RES.SET.2-10K.1/8W QTY 2 4701-03 1002	142-501-64A	WVTK	4789-00-0019	1
R45 R46 R52 R53	RES.SET.4-4.99K 1/8W QTY 4 4701-03-4991	180-300-100A	WVTK	4789-00-0039	1
CR21	DIODE.ZENER 6.2V	1N823A	MOT	4801-01-0823	1
CR7 CR8	DIODE	1N4581	MICRO	4801-01-4581	2
CR1 CR2 CR3 CR4 CR5	DIODE	1N4002	FAIR	4801-02-0001	5

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO 1100-00-0213 | REV G | PAGE 7

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
CR6					
CR10 CR11 CR12 CR9	DIODE	FD777	FAIR	4007-02-0777	4
CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR22 CR23 CR24	DIODE	1N4148	FAIR	4007-02-4446	11
Q21	TRANS	2N2219A	NSC	4901-02-2191	1
Q22	TRANS	2N2905A	NSC	4901-02-9051	1
Q6 Q7 Q8	TRANS	2N3638A	CARTR	4901-03-6381	3
Q2 Q20 Q3 Q4 Q9	TRANS	2N3903	NSC	4901-03-9030	5
Q10 Q11 Q19	TRANS	2N3905	ITT	4901-03-9050	3
Q12 Q13 Q14 Q15 Q18	TRANS	2N5139	FAIR	4901-05-1390	5
Q5	TRANS	TIP-29	TI	4902-00-0290	1
Q1	TRANS	TIP-30	TI	4902-00-0300	1
Q16 Q17	TRANS M/PR/2N3903 QTY 2 4901-03-9030	182-303-102	WVTK	4998-00-0013	1
°	WAFER	147-400	WVTK	5104-02-0013	1
NONE	SWITCH STOP	219-33-001-01-22	CTS	5104-07-0003	1
NONE	DETENT MOD FROM 5104-01-0010	180-313	WVTK	5104-99-0024	1
NONE	DETENT MOD	180-314	WVTK	5104-99-0025	1

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO 1100-00-0213 | REV G | PAGE 8

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	FROM 5104-01-0010				
RT1	THERMISTER	L312J2	FNWL	5300-00-0002	1
IC1	IC	LM 301AN	NSC	7000-03-0100	1
IC8	IC	LM318H	AMD	7000-03-1800	1
IC2 IC3 IC4	IC	LM741CN	NSC	7000-07-4100	3
IC11	IC	CA-3019	FAIR	7000-30-1900	1
IC7	IC	CA-3054	RCA	7000-30-5400	1
IC5	IC	CA-3096AE	RCA	7000-30-9600	1
VR1	VOLTAGE REGULATOR	MA78D5UC	FAIR	8000-78-0500	1
IC10	IC	74132	TI	8007-41-3200	1
IC9	IC	MC4044P	MOT	8-00 40-44 4	1

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO 1100-00-0213 | REV G | PAGE 9

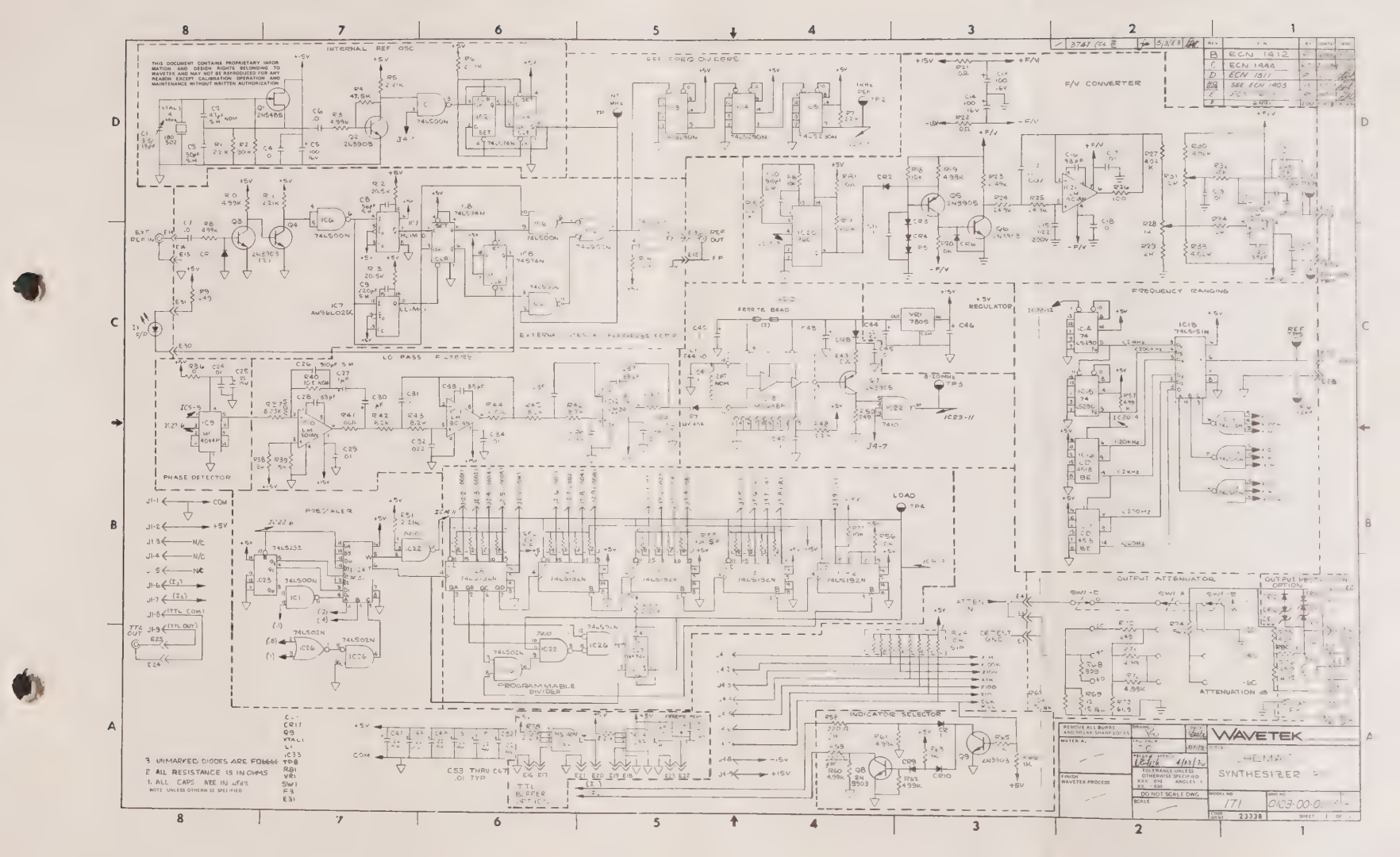
NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DRAWN | DATE | TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.02 ANGLES ±1° | DO NOT SCALE DWG | SCALE

WAVETEK SAN DIEGO, CA. U.S.A.

TITLE: PARTS LIST MAIN

MODEL NO 171 | DWG NO 1100-00-0213 | REV O | CODE IDENT 23338 | SHEET 2 OF 2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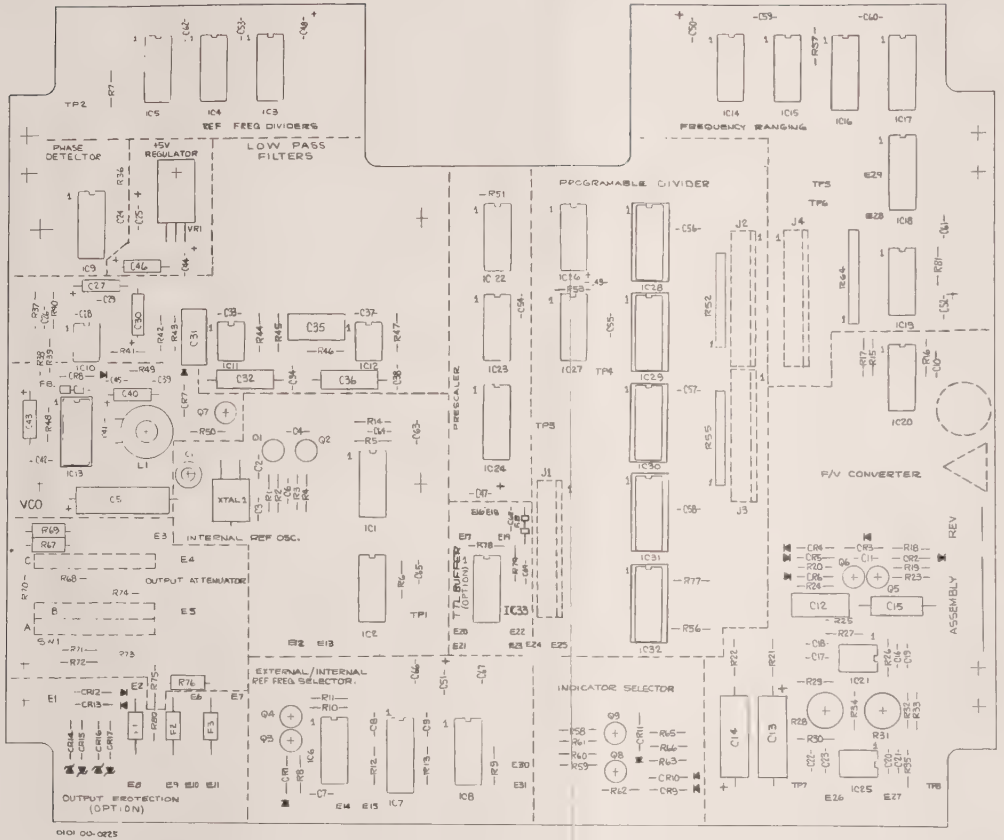
INTERNAL REF OSC
REF COMP OVLERS
F/V CONVERTER
FREQUENCY RANGING
REGULATOR
LO PASS FILTERS
PHASE DETECTOR
PRESCALER
PROGRAMMABLE DIVIDER
OUTPUT ATTENUATOR
OUTPUT VERNIER OPTION
INDICATOR SELECTOR
TTL BUFFER
LOAD
ATTENUATION dB
REV
DESCRIPTION
ECN 1412
ECN 1444
ECN 1511
SEE ECN 1405
WAVETEK
SYNTHESIZER
MODEL NO.
171
DRWG NO.
0103-00-0
SIZE
D
SCALE
DO NOT SCALE DWG.
SHEET 1 OF 2
3 UNMARKED DIODES ARE FDH666
2 ALL RESISTANCE IS IN OHMS
1. ALL CAPS ARE IN uFds
NOTE UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP
E	ECN 1809	JRM	4-4-76	
F	ECN 2467	LDD	11-4-8	



NAVETEK
0101-00-0225 F
SYNTHESIZER BD.
R 4-23-76
4-30-76
1 of 2

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, SYNTH	0101-00-0225	WVTK	0101-00-0225	1
NONE	SCHEMATIC, SYNTH	0103-00-0225	WVTK	0103-00-0225	1
NONE	QA PROC, SYNTH	0107-00-0225	WVTK	0107-00-0225	1
L1	TRANS, TORROID	3600-00-0011	WVTK	1204-00-0518	1
1	SPACER	144-306	WVTK	1400-00-2123	2
NONE	PLATE, SW	008-004	WVTK	1400-00-2130	1
2	SHIELD	1400-00-3823	WVTK	1400-00-3823	1
C17 C18 C19 C21 C22 C23 C24 C29 C34 C38 C39 C4 C43 C52 C54 C55 C56 C57 C58 C59 C6 C60 C61 C62 C63 C64 C65 C66 C67 C7	CAP, CER, MN, , 01MF, 50V	CAC0Z3SU103Z100A	CORNG	1500-01-0310	30
C11 C41 C42	CAP, CER, MON, , 1MF, 50V	CAC0Z3SU104Z050A	CORNG	1500-01-0403	3
C16 C20 C28 C33 C37	CAP, CER, 33PF, 1KV	DD-330 LONG LEAD	CRL	1500-03-3001	5
C9	CAP, MICA, 220PF, 500V	DM15-221J	ARCO	1500-12-2100	1
C3	CAP, MICA, 30PF, 500V	DM15-300J	ARCO	1500-13-0000	1
C27	CAP, MICA, 47PF, 500V	DM15-470J	ARCO	1500-14-7000	1
C8	CAP, MICA, 56PF, 500V	DM15-360J	ARCO	1500-15-6000	1
C10 C26	CAP, 910PF, 100V, 5%	DM15-911J	ARCO	1500-19-1100	2

WAVETEK PARTS LIST | TITLE: PCA, SYNTHESIZER | ASSEMBLY NO. 1100-00-0225 | PAGE 1 | REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C13 C14 C5	CAP, ELECT, 100MF, 16V	30001079016DC7	SPRAG	1500-31-0101	3
C12 C31 C35	CAP, MYLAR, , 1MF, 100V	225P10491WD3	SPRAG	1500-41-0444	3
C15 C32 C36	POLYE, .022MF, 200V	192P22392	SPRAG	1500-42-2304	3
C1	VARI, 3.5-13PF, 250V	78-TRIKO-02 3.5/13PF	TRIKO	1500-51-3000	1
C27 C30 C40 C43 C46	CAP, TANT, 1MF, 35V	150D105X9035A2	SPRAG	1500-71-0502	5
C25 C44 C47 C48 C49 C50 C51 C52	CAP, TANT, 22MF, 20V	202A200226M3	MATSO	1500-72-2621	8
NONE	SYNTHESIZER BD	1700-00-0225	WVTK	1700-00-0225	1
J1 J2 J3 J4	CONN, 9PIN	09-60-1091	MOLEX	2100-02-0052	4
SKT6	SKT, IC, 14 PIN	DILB14P/108	BURND	2100-03-0066	1
SKT1 SKT2 SKT3 SKT4 SKT5	SKT, IC, 16 PIN	DILB16P-108	BURND	2100-03-0067	5
NONE	SOLDER LUG	1497	SMITH	2100-04-0012	1
3	PIN, MALE	61182-2	AMP	2100-05-0020	27
XTAL1	CRYSTAL, 4MHZ	180-502	WVTK	2300-99-0004	1
4	STANDOFF, SWAGE, .625 H, .250 HEX 6-32, .062 MAT'L	15318-5/8	USECO	2800-02-0004	4
5	FERRITE BEAD	56-590-65/38	FERRI	3100-00-0001	2

WAVETEK PARTS LIST | TITLE: PCA, SYNTHESIZER | ASSEMBLY NO. 1100-00-0225 | PAGE 2 | REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R28	POT, TRIM, 1K	91A1K	BECK	4600-01-0209	1
R31	POT, TRIM, 2K	91A2K	BECK	4600-02-0201	1
R38 R39	RES, C, 1/2W, 5%, 220	RC20GF-221	STKPL	4700-25-2200	2
R26 R41 R44 R47	RES, MF, 1/8W, 1%, 100	RN55D-1000F	TRW	4701-03-1000	4
R63 R65 R66	RES, MF, 1/8W, 1%, 1K	RN55D-1001F	TRW	4701-03-1001	3
R16 R18 R20 R32 R35 R40T R5A R77	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	8
R21 R22 R36 R49 R81	RES, MF, 1/8W, 1%, 10	RN55D-10R0F	TRW	4701-03-1009	5
R30	RES, MF, 1/8W, 1%, 13K	RN55D-1302F	TRW	4701-03-1302	1
R37	RES, MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	1
R42 R43 R45 R46	RES, MF, 1/8W, 1%, 18.2K	RN55D-1822F	TRW	4701-03-1822	4
R29 R34	RES, MF, 1/8W, 1%, 2K	RN55D-2001F	TRW	4701-03-2001	2
R12 R13	RES, MF, 1/8W, 1%, 20.5K	RN55D-2052F	TRW	4701-03-2052	2
R1 R11 R14 R15 R17 R48 R5 R51 R53 R6 R7	RES, MF, 1/8W, 1%, 2.21K	RN55D-2211F	TRW	4701-03-2211	11
R50 R70 R9	RES, MF, 1/8W, 1%, 249	RN55D-2490F	TRW	4701-03-2490	3
R23	RES, MF, 1/8W, 1%, 2.49K	RN55D-2491F	TRW	4701-03-2491	1
R24 R25	RES, MF, 1/8W, 1%, 24.9K	RN55D-2492F	TRW	4701-03-2492	2

WAVETEK PARTS LIST | TITLE: PCA, SYNTHESIZER | ASSEMBLY NO. 1100-00-0225 | PAGE 3 | REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R2	RES, MF, 1/8W, 1%, 301K	RN55D-3013F	TRW	4701-03-3013	1
R27 R30 R33	RES, MF, 1/8W, 1%, 4.02K	RN55D-4021F	TRW	4701-03-4021	3
R4	RES, MF, 1/8W, 1%, 47.5K	RN55D-4752F	TRW	4701-03-4752	1
R71 R75	RES, MF, 1/8, 1%, 499	RN55D-4990F	TRW	4701-03-4990	2
R10 R19 R3 R57 R60 R61 R62 R72 R8	RES, MF, 1/8W, 1%, 4.99K	RN55D-4991F	TRW	4701-03-4991	9
R74	RES, MF, 1/8W, 1%, 56.2	RN55D-56R2F	TRW	4701-03-5629	1
R73	RES, MF, 1/8W, 1%, 61.9	RN55D-61R9F	TRW	4701-03-6199	1
R37T	RES, MF, 1/8W, 1%, 8.25K	RN55D-8251F	TRW	4701-03-8251	1
R68	RES, MF, 1/8W, 1%, 909	RN55D-9090F	TRW	4701-03-9090	1
R69	RES, MF, 1/4W, 1%, 121	RN60D-1210F	TRW	4701-13-1210	1
R67	RES, MF, 1/4W, 1%, 124	RN60D-1240F	TRW	4701-13-1240	1
R76	RES, MF, 1/4W, 1%, 49.9	RN60D-49R9F	TRW	4701-13-4999	1
R52 R55 R64	RES MODULE, 10K	4310R-101-103	BOURN	4770-00-0008	3
CR7	DIODE	HV1404	HOT	4803-02-1404	1
CR1 CR10 CR11 CR2 CR3 CR4 CR5 CR6 CR8 CR9	DIODE	1N4148	FAIR	4807-02-6666	10
Q2 Q3 Q4 Q6 Q8 Q9	TRANS	2N3903	NSC	4901-03-9036	6

WAVETEK PARTS LIST | TITLE: PCA, SYNTHESIZER | ASSEMBLY NO. 1100-00-0225 | PAGE 4 | REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q5 Q7	TRANS	2N3905	ITT	4901-03-9050	2
Q1	TRANS	2N5403	MOT	4901-05-4830	1
SW1A SW1B SW1C	WAFER	142-SW1-1	WVTK	5104-02-0013	3
NONE	SWITCH STOP	213-33-001-01-22	CTS	5104-07-0003	1
SW1	MODIFIED DETENT FROM: 5104-01-0010	5104-99-0026	WVTK	5104-99-0026	1
IC10 IC11 IC12 IC21 IC25	IC	LM 301AN	NSC	7000-03-0100	5
IC16 IC17	IC	CD4518BE	RCA	8000-43-1810	2
IC1 IC4	IC	74LS00	TI	8000-74-0010	2
IC24	IC	74LS02	TI	8000-74-0210	1
IC22	IC	7410	TI	8000-74-1000	1
IC19	IC	74LS10	TI	8000-74-1010	1
IC27	IC	74S74	TI	8000-74-7401	1
IC2 IC8	IC	74LS74	TI	8000-74-7410	2
VR1	VOLTAGE REGULATOR	MA7805UC	FAIR	8000-78-0500	1
IC20	IC	B601/9601	FAIR	8000-86-0100	1
IC7	IC	96L02	FAIR	8000-96-0210	1

WAVETEK PARTS LIST | TITLE: PCA, SYNTHESIZER | ASSEMBLY NO. 1100-00-0225 | PAGE 5 | REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
IC24	IC	74151	TI	8007-41-5100	1
IC18	IC	74LS151	TI	8007-41-5110	1
IC20 IC29 IC30 IC31 IC32	IC	74LS192	TI	8007-41-9210	5
IC14 IC15 IC3 IC4 IC5	IC	74LS290	TI	8007-42-9010	5
IC23	IC	74LS293	TI	8007-42-9310	1
IC13	IC	MC1648P	MOT	8100-16-4810	1
IC9	IC	MC4044P	MOT	8100-40-4400	1

WAVETEK PARTS LIST | TITLE: PCA, SYNTHESIZER | ASSEMBLY NO. 1100-00-0225 | PAGE 6 | REV L

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST PCA, SYNTHESIZER
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XX ± .010 ANGLES ± 1° .XX ± .005		
	DO NOT SCALE DWG	MODEL NO. 171	DWG NO. 1100-00-0225 REV
	SCALE	CODE IDENT 23338	SHEET 1 OF 1

8/24/07 GRAPHICS/ACCUPRESS REVISION NO. A-3864

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG: PIGGYBACK	0101-00-0908	WVTK	0101-00-0908	1
C2	CAP.CER.:10PF.1KV	DD-100	CRL	1500-01-0011	1
C1 C3	CAP.CER.MN..01MF.30V	CAC0Z2SU103Z1G0A	CORNG	1500-01-0310	2
NONE	PIGGYBACK BOARD	1700-00-0908	WVTK	1700-00-0908	1
R1	POT.TRIM.10K	91AR10K	BEC#	4600-01-0315	1
R2	RES.MF.1/8W.1%.1.5K	RN55D-1501F	TRW	4701-03-1501	1
R3	RES.MF.1/8W.1%.301	RN55D-3010F	TRW	4701-03-3010	1
R4	RES.MF.1/8W.1%.6.81K	RN55D-6811F	TRW	4701-03-6811	1
Q1	TRANS	2N3904	FAIR	4901-03-9040	1
IC1	IC	CA0807	RCA	7000-00-8000	1

WAVETEK PARTS LIST	TITLE PCA: PIGGYBACK BOARD	ASSEMBLY NO. 1208-00-0908 PAGE 1	REV

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROTENCH		TITLE: PARTS LIST PCA, PIGGYBACK BOARD
FINISH: WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG	MODEL NO 171	DWG NO 1208-00-0908 REV
	SCALE	CODE IDENT 23338	SHEET 1 OF 1

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